THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

CONDUCTED BY

ALBERT C. L. G. GÜNTHER, M.A., M.D., Ph.D., F.R.S.,
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WILLIAM CARRUTHERS, F.R.S., F.L.S., F.G.S.,
AND
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1885.

"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Théorie du Système Animal,* Leyden, 1767.

. . . . The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain-thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.

ALERE FLAMMAM.

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THE ANNALS AND MAGAZINE OF NATURAL HISTORY,

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No. XCI.

JULY 1885.

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ALBERT C. L. G. GÜNTHER, M.A., M.D., PH.D., F.R.S.,
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BEING A CONTINUATION OF THE "ANNALS" COMBINED WITH MESSRS. LOUDON AND CHARLESWORTH'S "MAGAZINE OF NATURAL HISTORY."

WITH TWO PLATES.

Illustrative of Mr. J. J. Quelch's Paper on Deep-sea and Shallow-water Hydrozoa.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

"................ per litora spargite muscum,
Naiades, et circùm vitreos considite fontes:
Pollice virgineo teneros hìc carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasii Ecl. 1.

No. 91. JULY 1885.

I.—*On some Deep-sea and Shallow-water Hydrozoa.* By JOHN J. QUELCH, B.Sc. (Lond.), Natural History Museum.

[Plates I. & II.]

THE forms described in the present paper consist chiefly of deep-sea Hydroida which were obtained by Mr. C. A. Bishop while engaged in repairing the cable off the Cape Verde Islands. With the exception of the variety of *Diphasia pinaster*, which was taken by Mr. Bishop from the Madeira cable off Lisbon, and the specimens of *Cryptolaria conferta* presented by Miss M'Lea, the Hydroida were taken by Mr. Bishop from the cable off S. Antonio, the depth being, as Mr. Bishop assured me, over 500 fathoms. Though but a very small collection, yet the forms obtained are of great interest, since they belong, with but one exception, either to new or rare species, and throw considerable light on the classification of their allied forms. As a contribution to our knowledge of the Hydroida at great depths the collection is a valuable one, while the many points which it serves to elucidate in the characters of structures which had hitherto been imperfectly known or altogether misunderstood give to it a special interest. A definite contribution is thus made to our know-

ledge of the gonosome of *Streptocaulus*, which throws considerable light on corresponding parts in other genera; while many facts in the variability of the corbula in *Aglaophenia*, in the development of the ramuli in *Streptocaulus* and *Antennularia*, and in the occurrence of nematophores in forms (*Zygophylax*) other than the Plumulariidæ are clearly established.

The specimens were obtained under circumstances of great personal inconvenience by Mr. Bishop as the cable came in, and were carefully dried, preserved, and brought to the British Museum, since, as he expressed to me, he thought it likely that any specimens from the deep sea might be of interest to naturalists. Mr. Bishop has thus earned the thanks of all zoophytologists for this contribution which he has made to their science, and has at the same time set an example to all those who, whatever may be their station in life, have more or less favourable chances of adding to our stock of knowledge.

The specimens of *Cryptolaria* presented by Miss M'Lea are especially interesting, since they show the nature of the gonotheca. Of much interest also are the specimens of *Distichopora granulosa* and *D. conferta*.

Order HYDROIDA.

Family **Eudendriidæ**.

Eudendrium annulatum.

Eudendrium annulatum, Norman, Ann. & Mag. Nat. Hist. 1864, p. 83, pl. ix. figs. 1–3.

Two small specimens were obtained, which I have doubtfully referred to this rare species, with which they agree in their shrubby habit, in their regularly annulated branches, and in the irregular network of small tubes which cover the surface of the main stems. It seems to differ, however, in that its ramules are often much elongated, while the whole hydrophyton seems to be thinner and much more delicate throughout.

Family **Lafoëidæ**.

Lafoëa tenellula.

Lafoëa tenellula, Allman, Mem. of Mus. Comp. Zool. Cambridge, U.S.A. vol. v. no. 2, p. 12, pl. viii. figs. 3 & 4.

Several specimens growing together on a portion of the cable are referable to this species. The specimen on which the species was founded evidently was quite a young one; for though the ultimate ramuli and the hydrothecæ are com-

paratively minute, yet the whole hydrophyton may attain with age a comparatively large size, becoming erect or suberect and branched, with the stem and chief branches fascicled. The peduncle of the hydrotheca is very variable in thickness, but it never becomes very thin; the rings of elongation of the hydrotheca are generally very distinct and from two to four in number. Height of the largest specimen about 80 millim. when placed in water and allowed to disentangle itself from the closely curled manner in which it dries.

Cryptolaria conferta. (Pl. II. fig. 1.)

Cryptolaria conferta, Allman, Mem. of Mus. Comp. Zool. Cambridge, U.S.A. vol. v. no. 2, p. 17, pl. xii. figs. 6–10.

Specimens which do not seem to me to differ from this species have been presented to the British Museum by Miss M'Lea. On some specimens, which I regard as female stocks, occur curious large elongated bodies, which call to mind the large elongated gonothecæ of various species of *Campanularia*, and which leave no doubt in my mind that they are the real gonothecæ of the species. These bodies are placed on the branchlets and on the distal portion of the main branches, and are directly continuous with one of the fascicled tubes of the stem. They are about from four to six times the length of the free portions of the hydrothecæ on the distal parts, elongato-cylindrical with a plain circular orifice, constricted at the base, where they join the tube of the stem, and attached throughout their whole length to the branch or branchlet from which they arise. They are often much covered at different parts by small fascicled tubes of the stem.

Different structures have been described by Prof. Allman, Mr. S. F. Clarke, and Mr. J. W. Fewkes as occurring on various species of *Cryptolaria*, which have been regarded by them with more or less certainty as being the gonosomes of those species. In the second part of the narrative of the cruise of the 'Challenger,' p. 752, in a note on the Hydroida, Prof. Allman, however, states that on a specimen of this genus, from a depth of 2600 fathoms, "we have been made acquainted with its gonosome, which had not previously been detected." As there have been so many different views as to the structure of these parts, I have deemed it advisable to notify the presence of gonothecæ on this specimen, in order that it may afford what confirmation may be possible to this later view of Prof. Allman.

Loc. North Atlantic. Lat. 48° 33′ 52″, long. 10° 33′ 14″. Brought up by the sounding-wire from a depth of 500 fathoms (*Mr. Hamilton*).

Family **Zygophylacidæ.**

Hydrothecæ continuous with, but not jointed to, a lateral process of the stem; paired nematophores or nematophore-like bodies at the base of the hydrothecæ, one nematophore being on each side on the lateral process.

ZYGOPHYLAX, nov. gen.

Hydrocaulus erect, branched, composed of many tubes aggregated together; branches unjointed; hydrothecæ biserial, alternate, tubular, sessile, narrowed and constricted towards the base, and continuous with a slightly enlarged lateral projection of the stem. On the raised lateral edges of this process are placed two small, elongated, tubular structures, one on each side at the base of the hydrothecæ, which are constricted and jointed towards their base, and which do not appear to differ in any essential particular from the jointed, stalked nematophores which are characteristic of so many of the Plumulariidæ.

Reproduction unknown.

This genus is only known in the dry state; and the characters of its hydrophyton relate it, on the one hand, to the Lafoëidæ, and on the other to the Haleciidæ. It differs essentially, however, from the forms included under those families, and notably so in the possession of the paired nematophores at the base of the hydrothecæ—a character so striking and constant as to justify, in my opinion, the formation of a new family to receive it.

Prof. Allman, in his Report on the Plumulariidæ of the 'Challenger' expedition (p. 6), has given an extremely valuable note on our knowledge of the occurrence of nematophores or nematophore-like bodies in Hydroids other than the Plumulariidæ, and it is interesting to note that such bodies occur on forms allied or referable to *Lafoëa* and *Halecium*. The present form adds another to the list with much the same relation, though the certainty of its position in classification, based on the details of the structure of the complete hydrosoma, must await the confirmation derivable from fresh or well-preserved specimens.

Zygophylax profunda, n. sp. (Pl. I. fig. 4.)

Stem fascicled, erect, much branched; branches very thin, springing immediately from beneath a hydrotheca, which therefore becomes placed in the axil of the branch. Hydrothecæ very small, alternately placed at regular intervals, short, tubular, and curved so as to look outwards and downwards, with two or three annulations generally well deve-

loped near the margin, the base much constricted and connected with a distinct but small process of the stem; aperture of the hydrotheca circular. Nematophores extremely small, elongated, being more than half the length of the hydrotheca, slightly ringed near the margin, and jointed below to a thicker basal portion which is placed on the proximal side of the base of the hydrotheca.

The specimens of this species form small branched colonies which are about 30 or 40 millim. in height, and when dried are of an earthy brown colour. They were found growing on the cable and also attached to specimens of *Diphasia pinaster*. In these dried specimens the delicate nematophores are often found more or less broken away, but the remaining basal portion easily marks their original position on each side of the base of the hydrothecæ.

Family **Sertulariidæ.**

Diphasia pinaster.

Sertularia pinaster, Ellis & Solander, Zooph. p. 55, pl. vi. figs. *b* & B.
Diphasia pinaster, Hincks, British Hydroid Zoophytes, p. 252, pl. 50. fig. 1.

Several specimens of this species were obtained. They agree in nearly every particular with the characteristic form of the species, except that the female gonothecæ are usually tetraspinous, bearing only the single lower circle of spines, while occasionally on other gonothecæ on the same hydrophyton two very small spines of the upper circle are also present. In accordance with the position and prominence of the four larger spines, the female gonothecæ have when dried a more or less quadrangular shape. The spines on the female gonothecæ of this species are thus seen to vary from four to eight. The male gonothecæ are much smaller, and have the characteristic quadrangular shape, with the four angles produced into very prominent spines.

To this species I have referred, somewhat doubtfully, some other specimens obtained from the Madeira cable off Lisbon, in which the distinct fold at the point of divergence of the superior half of the hydrotheca is scarcely or not at all represented. In other respects, in the characters of the hydrothecæ and in the habit of the hydrophyton, they are closely like the present species. They present a decided approach to the *D. coronifera* and the *D. elegans*. No gonothecæ are present on the specimens, and the final position of the form must remain doubtful until the nature of these structures is observed. For the present I distinguish it as

Diphasia pinaster, var. *arcuata.*

Family **Plumulariidæ.**

Several of the genera of this family are in great need of revision. The characters by means of which *Plumularia*, for instance, is separated from *Antennularia* are now become extremely vague, since the verticillate arrangement of the ramuli in the latter has had to be abandoned as a generic character. In *Antennularia* the ramuli may be few or many, verticillate or scattered, while in the young colonies and on the basal parts of more advanced ones the ramuli are placed singly and alternately, becoming afterwards placed in pairs, a condition that obtains in the young forms of our common *Antennularia antennina*. *Plumularia* does not thus seem to have any constant natural character by which to separate it from *Antennularia*. The genera *Antennopsis* and *Hippurella* seem also inseparable from *Plumularia* and *Antennularia*. In speaking of *Hippurella*, I use the name as defined by Prof. Allman in his "Report on the Hydroids of the Gulf-stream," where it is stated that the "ultimate ramuli are alternate and pinnate towards the proximal ends of the branches, but towards the distal ends surrounding the branches on all sides, and here either scattered or regularly verticillate; each composed of alternate long and short internodes with intervening groups of very short ring-like internodes, each of the long internodes carrying a hydrotheca."

Mr. J. W. Fewkes states (Bull. Mus. Comp. Zool. Cambridge, U.S.A. vol. viii. p. 134) that in a form which he has identified as *Hippurella annulata*, Allman, these verticillate branches are but verticillate ribs, destitute of hydrothecæ, and that they bear simply a row of nematophores, being thus a special form of the phylactocarp in which the gonophores are borne between successive verticils of these ribs. Mr. Fewkes has not stated, so far as I am aware, that this is a redescription based on a reexamination of Allman's type specimen, so that, until such information be forthcoming, in the face of the explicit statement of Prof. Allman quoted above from his description, it seems unavoidable to conclude that Mr. Fewkes has described some form which, though closely agreeing in many of its features with the *Hippurella annulata*, Allman, is quite distinct from it, and is truly referable to a new genus.

Plumularia variabilis, n. sp. (Pl. II. fig. 2.)

Hydrocaulus attaining a height of more than 60 millims., simple, slender, not fascicled, very indistinctly jointed, and

springing from a tangled mass of small tubular filaments; pinnæ alternate, distichous, extremely thin and slender, each borne close to the distal end of an internode of the stem, where it is supported by a long process much swollen at the base; the mode of jointing of the pinnæ is most variable, the proximal internode is short and destitute of hydrotheca, and is often followed by one or two short internodes before the hydrotheca-bearing internode, so that there may be one, two, or three distinct internodes between the process of the stem and the first hydrotheca-bearing internode; the hydrotheca-bearing internodes always long, frequently alternating with one long non-hydrothecate internode, and not unfrequently with two or three shorter ones, while, as frequently the internodes which follow one another all bear a hydrotheca; in this latter case the internodes are extremely elongated, and instead of bearing the hydrotheca towards the centre of their length, bear them near their proximal extremity. Hydrothecæ very small and shallow, their width and depth scarcely exceeding the general diameter of the pinna. Nematophores extremely numerous. Besides the pair placed at the sides of the hydrotheca there is a single nematophore on the proximal part of each hydrotheca-bearing internode, and in those cases in which these internodes are much elongated and follow directly on one another, two nematophores are placed at short distances on their distal portion. On the long intervening internode two nematophores are present, and when this is replaced by two or more shorter ones, each then bears a single nematophore. The proximal internodes which follow the process bear a nematophore, and the internodes of the stem carry ten or more; of these, two are carried on each side of the internode in a line above the pinnæ, so that there are four nematophores between successive pinnæ on the same side of the stem; one is placed on each side of the proximal part of the internode between the rows of alternate pinnæ, while two pairs are placed on the process which carries the pinna, one at its upper and one at its lower end.

The gonothecæ are short, suboval or slipper-shaped, and slightly curved to one side, with an oval subterminal orifice, borne singly or in pairs on the swollen base of the processes of the stem in the axils of the pinnæ.

In the dried specimens of this species a curious torsion of the stem is observable, so that instead of there being two straight rows of alternate pinnæ, a complete spiral is formed by these rows in about a length of 30 millim. In this state the arrangement of the pinnæ is singularly similar to what is found in the genus *Antennopsis*, Allman, which, judging by

the figures given, can hardly be separated from *Plumularia*, since in all essential features the two genera seem to be identical, with but the slight exception that the single pinna borne by each joint occasionally departs in *Antennopsis* from the ordinary distichous alternate arrangement. This condition seen in the dried state of the present species entirely disappears when the specimen is placed in water; the torsion of the stem becomes lost and the specimen assumes the normal pinnate habit.

In many of its characters this species recalls *P. antennata* and *P. megalocephala*.

Plumularia delicatula, n. sp. (Pl. II. fig. 3.)

Hydrocaulus attaining a height of more than 100 millim., simple, not fascicled, very distinctly jointed, of very variable thickness in different specimens, and often quite slender, rather wiry, arising from a mass of tubular filaments. Pinnæ alternate, one on each internode, very thin and delicate, attached to a rather short process of the stem, which is scarcely or not at all swollen at the base; regularly jointed with oblique joints; alternate internodes bearing hydrothecæ and rather elongated, being nearly twice the length of the intervening internodes, which are about four times as long as they are broad; each internode more or less marked by slight annular constriction at their extremities, chiefly noticeable on the proximal internode of the pinna. Hydrothecæ rather deeper than their width, which is about twice the general diameter of the internodes. Nematophores numerous, two at the lateral margins of the hydrotheca and one at its proximal side, one on the intervening internode, one or two on the internode which is attached to the process of the stem; one on each side of the base of this process, and two placed singly along the stem on each internode in a line above the process of the internode below.

Gonothecæ borne in the axils of the pinnæ, flask-shaped, elongated, with a short neck.

The delicate pinnæ in this species are often broken off in dried specimens, when but a rather wiry stem is left. Its closest ally seems to be *Plumularia setacea*, from which it differs in the nature of the joints, in the relative length and thickness of the internodes, and in the disposition of the nematophores on the stem and on its processes.

Antennularia irregularis, n. sp. (Pl. II. fig. 4.)

Hydrocaulus simple, jointed, slightly thickened, attaining a

height of about 15–20 centim. or more, closely crowded to form wide dense tufts, the hydrorhiza of which has the form of a rather thin spreading mass of closely crowded entangled filaments of different sizes. Ramuli extremely slender, jointed, arranged in a very variable manner; on the basal part of the hydrocaulus they are alternate, placed singly, one to each joint, but in such a manner that they do not strictly fall in the same plane; higher up the stem they are arranged in pairs, the pairs decussating; while in the larger number of stems this condition is again lost at the upper part by the ramuli becoming placed in threes at each whorl, each three being so placed as to be vertically above or below every alternate three, so that a hexastichous arrangement is produced; these upper ramuli are borne on a long process (of the stem), which is slightly swollen at the base; one or two short internodes follow this process before the first hydrotheca-bearing internode, while between the hydrotheca-bearing internodes one long or two shorter internodes are placed. The internodes are very slender and usually much elongated. The hydrothecæ are small and shallow, slightly wider than the general diameter of the ramulus. Nematophores rather variably arranged; one below each hydrotheca on the same internode and two above it at the lateral margins, two on the intervening long internode or one on each of the replacing shorter ones, and one on each of the short proximal internodes following the process of the stem; on this process one or two nematophores are placed singly along the inner side, and one is placed on each side of the swollen base, nearly in the axil of the ramulus; one nematophore is placed on the stem directly above the point of origin of each ramulus.

Gonothecæ borne singly in the axil of the ramuli, rather short, suboval, and curved, with an oval subterminal orifice.

If the genus *Hippurella* as defined by Allman could be maintained, this form would have to be referred to it; but it seems to me impossible to retain that genus, since the varying position of the ramuli on which it is founded is a common characteristic of *Antennularia*, as shown by their earlier stages. In the common British species, *A. antennina*, the ramuli are at first arranged *alternately*, as in *Plumularia*, then in *pairs*, before attaining their verticillate condition (Hincks, Brit. Hydroid Zoophytes, vol. i. p. 281).

The species, in the general arrangement of its ramuli at different parts of its hydrocaulus, recalls the species *A. hexasticha*, *A. Johnstoni*, *A. decussata*, and *A. Janini*; but in essential characters it cannot be confounded with either of them.

Antennularia profunda, n. sp. (Pl. II. fig. 5.)

Hydrocaulus fascicled at the base and springing from a tangled mass of fine fibres, branched, erect, indistinctly or rarely jointed below, more numerously so above, attaining a height of more than 15 centim., and in the specimen obtained remaining unbranched with subopposite pinnate ramuli for nearly its whole height. At its upper end the ramuli lose their pinnate arrangement and become irregularly placed, forming four or six rows, two or three ramuli being often placed at the same level and alternating with those above and below them, but not closely crowded; where this subverticillate arrangement of the ramuli takes place, young branches on which the ramuli have the same subverticillate arrangement begin to develop. Ramuli thin and long, attached to a long process of the stem, which is swollen below, jointed, each internode bearing a hydrotheca, and having a length between three and four times its diameter. Hydrotheca small and shallow, its width being about equal to the diameter of the internode. Nematophores very numerous, four on each internode of the ramulus, one at its distal and one at its proximal part, and two at the lateral margins of the hydrotheca, two pairs on each of the lateral processes of the stems in the proximal portions of the colony, and three pairs on those in the upper portions, two on the proximal and three on the distal parts of the stem above the point of insertion of each ramulus, while lines of nematophores are found running up the stem between the rows of the ramuli. In the axil of each ramulus is a slight swelling with a small pore, apparently a base for the attachment of gonothecæ. Gonothecæ unknown.

This species is close to *A. ramosa*, from which it differs chiefly in its general habit, in the arrangement of the ramuli, in the relative length and thickness of the internodes of the stem and ramuli, and in the disposition of the nematophores on the stem. It differs markedly in essential characters from *A. tetrasticha*, which it much resembles in general habit. It is close to *A. norwegica*, but is easily distinguished by its branched hydrocaulus, its more verticillate ramuli, by the relatively short and thick smooth internodes, and the number and disposition of the nematophores throughout.

Aglaophenia acacia.

Aglaophenia acacia, Allman, 'Challenger' Hydroida, pt. i. p. 38, pl. xii. figs. 1–4.

Numerous specimens were obtained which differ in unim-

portant points from the 'Challenger' type specimens. They consist of simple unbranched stems, the larger of which are about 70 millim. in height, and they are thus destitute of the characteristic habit which marks the old specimens of the species. The type specimen figured in the report on the 'Challenger' Plumulariidæ was full-grown and evidently an old specimen, while the present specimens are but young forms. With the exception of this difference of habit, due to age, and of a slight difference in the corbula, the forms agree in every essential respect. The difference in the corbulæ presents itself in their variable length. Sometimes the corbula is composed of a few pairs of leaflets, especially in those at the distal parts of the colony, where there are usually about six or seven pairs, while again there may be present a large number of pairs, ten or more, which are chiefly placed on the proximal parts. The shape of the corbula consequently varies considerably, from a rounded oval to a narrow cylindrical form, the one passing insensibly into the other.

In essential characters this species seems to be extremely close to *A. tubulifera*, *A. calamus*, and *A. rigida*.

Streptocaulus pulcherrimus. (Pl. I. fig. 5.)

Streptocaulus pulcherrimus, Allman, 'Challenger' Hydroida, pt. i. p. 48, pl. xvi. figs. 1–3.

Of this beautiful and extremely interesting form five colonies were obtained, one of which attains a height of about 30 centim. They are especially interesting since they supply the characters of the gonosome which were wanting in the 'Challenger' specimens, while at the same time the origin of the spiral arrangement of the hydrocladia from the pinnate form is clearly seen at the proximal parts of the colonies. In some of the colonies the hydrocladia are absent from the basal part for a distance of about 5–8 centim., while in others they are continued nearly to the extreme base. These basal hydrocladia are confined to one side of the stem and are alternately arranged on each side of a line of more or less rounded adnate nematophores, and spread in opposite directions, thus having a strictly pinnate disposition. Above this basal part the planes of the hydrocladia gradually become closer, until the hydrocladia become placed in one and the same plane intermediate between their former positions, and are attached not on each side, but in the direct line of the nematophores of the stem. The torsion of the stem now gives the spiral arrangement which is so distinctive of this form. In the dried state this spiral arrangement is scarcely

or not at all perceptible; but on placing the specimen in water it assumes its normal habit.

The gonosome consists of gonothecæ, which are borne neither directly by the hydrocladia nor by modified protective branches, but are seated directly on jointed appendages of the hydrocladia, one gonotheca to each joint. These appendages are placed laterally at the upper basal part of the mesial nematophore, immediately below the base of the hydrotheca, and are always situated on the left side—left, that is, to one standing in the hydrotheca, so to speak, and looking towards its pointed margin. They are unbranched and jointed, and are placed either on consecutive mesial nematophores or irregularly. The joints are similar throughout, generally three or four in number to each appendage, narrowed at the base and expanded at the top, so as to be obconical or subtriangular; the expanded upper lateral edges chiefly formed by two rather short nematophores, one at each edge, between which is placed the narrow base of the joint above, while below this point of juncture and on the front of the joint (that is on that part which looks towards the hydrotheca below which the appendage is situated) is seated the gonotheca, which thus occupies the upper anterior portion of the joint. The remaining anterior portion of the joint is evenly divided by two transverse constrictions.

The gonothecæ are sessile and elongato-pyriform, with a suboval subterminal orifice; they are placed one on each joint of the appendage, and, where broken away, leave their base of attachment exposed to view.

From the structure of the parts thus described it will be seen that the genus *Streptocaulus* calls to mind the peculiar condition found in *Cladocarpus*, in which the ramuli bearing gonothecæ are not strictly modified hydrocladia, but appendages of the hydrocladia, with this essential distinction, however, as it seems to me, that while in *Cladocarpus* these structures may possibly be imagined as being more or less protective, and thus as peculiar forms of the phylactocarp according to the definition of Prof. Allman, yet in *Streptocaulus* they can in no sense be considered as protective, but seem rather to be a repetition on a more complete scale of the structures found in such a genus as *Schizotricha*.

In *Schizotricha* the gonothecæ are not strictly borne by the hydrocladia, but on a basal portion which seems strictly homologous with the reproductive ramuli of *Cladocarpus*. A multiplication of such parts as the basal segments of *Schizotricha*, giving a jointed ramulus, in which each joint bears

lateral nematophores and a gonotheca, is the exact condition found in *Streptocaulus*; while in *Cladocarpus* this condition is carried a step further, in that the ramuli become branched, with few or many joints, some of which only bear gonothecæ.

Schizotricha has been referred by Prof. Allman to the section *Gymnocarpa* of the Eleutheroplea, and *Cladocarpus* to the section *Phylactocarpa* of the Statoplea; and, judging on the point of function as to whether the reproductive appendages of the hydrocladia on which the gonothecæ are placed are or are not protective, the genus *Streptocaulus* must be removed from the Phylactocarpal Statoplea, among which it was temporarily placed, to the section *Gymnocarpa*. On the other hand, since the reproductive appendages and segments which bear the gonothecæ seem in the three cases to be strictly homologous, and thus but rudimentary or varying forms of the phylactocarp, it seems necessary, if the terms *Gymnocarpa* and *Phylactocarpa* are to be retained with any definite meaning, that all three genera should be placed among the phylactocarpal forms.

Order HYDROCORALLINEÆ.

Family **Stylasteridæ.**

In the following descriptions of new species of the genus *Distichopora* detailed mention is made of the characters of the surface of the cœnosteum, of the form and mode of arrangement of the pore-rows, of the relative size, shape, and position of the gastropores and dactylopores, and of the nature of the ampullæ. Short descriptions, with special reference to these characters, are also given of those previously-described species which agree with them more or less closely in general form and coloration, in order to point out the more marked differences which are presented by those species. The characters of the ampullæ call for special notice in the diagnosis of the species, since well-marked differences in the structure of these parts obtain in different species of the genus. Such certainly may be affirmed after a very careful examination of a large number of stocks in which the ampullæ present the appearance of raised more or less vesicular swellings on the cœnosteum. For the figures given of the cyclosystems parts have been selected at some distance from the extreme apical points, since at such points the dactylopores become markedly tubular and prominent in all or nearly all species of *Distichopora*.

Distichopora granulosa, n. sp. (Pl. I. fig. 1.)

Cœnosteum branched, regularly flabelliform, somewhat incrusting at base, of a rich scarlet-red colour on the distal portion of the main branches and throughout the branchlets even to the tips, except where fracture has taken place at the extremities, the small commencing growth at such points being very pale reddish; on the basal part of the main branches and on the incrusting portion the colour becomes of a pink-red. Branches short and thick for the size of colony, being about 7–12 millim. thick at the base of branches that are about 30 millim. in length, and diminishing gradually in size to about 2 millim. diameter at the tips, compressed at the base, round above; branchlets short, round, obtuse, rather thickened at the base and about 2 millim. thick at the apex, which is often slightly expanded where division is taking place. Cœnenchyma dense, the surface conspicuously roughened and granulated either by crowded bluntly conical eminences, between which are placed small scattered pores, or by sinuous irregularly confluent or reticulated ridges, which are more usually found towards the distal parts of the cœnosteum.

Cyclosystems regularly arranged on opposite sides in distinct, deep, continuous lateral furrows, the width between the outer edges of the dactylopores being about ·75 millim. Gastropores rather small, circular or slightly elongated transversely, slightly unequal and unequally separated, the partition between them often equal to their diameter, and not rising above the bottom of the furrow; style deep, very thin, and obsoletely hirsute; in section the gastro-canal is seen to be nearly smooth. Dactylopores large in comparison with the gastropores, being about one third to one fifth the size of the larger gastropores, placed on the margin of the furrow, at distances apart generally exceeding their width, elongated transversely, with their outer and lateral margins much elevated above the surrounding surface, so as to present in profile a series of distinct tubular or spout-shaped eminences; the inner margin is generally wanting, so that the dactylopores open on that side into the gastropore furrow. Ampullæ abundant, scattered irregularly or closely grouped, forming rounded eminences about ·75 millim. in diameter, marked on the upper surface by the small sinuous irregular ridges which are characteristic of the cœnosteum, between which are several small scattered irregular pored openings, which communicate with a single cavity within; the walls of the ampullæ become very thin with age, and finally break away.

Locality. Raratonga? B.M.

Two specimens of this handsome species were presented to the national collection by Prof. Flower.

A marked feature of this species is the strikingly rich coloration, which is continued even to the tips of the cœnosteum, except where fresh growth, consequent on fracture, has commenced. This character, with the special structure of its cœnenchyma and of its cyclosystems, will readily serve to distinguish it from all other species. Special attention must be called to the decided resemblance which obtains between the forms of the dactylopores in this species and in those of the genus *Errina.*

Distichopora conferta, n. sp. (Pl. I. fig. 3.)

Cœnosteum forming an intricately and crowdedly branched fastigiate clump, in which the branchlets on the separate branches are arranged in a more or less flabellate manner; of a delicate carmine-red colour, with whitish tips. Branches much divided, short, very slender and round, slightly compressed at the extreme base, and very seldom coalescent; branchlets very small, round, obtuse, about 1·5 millim. thick at the apex, which is slightly expanded where division is taking place. Cœnenchyma dense, the surface strongly granulated, marked throughout by small, crowded, conical eminences, between which are minute scattered pores. Cyclosystems regularly arranged on opposite sides in continuous rows, seldom forming furrows, except at the extreme apical points, since the partitions between the gastropores are usually level with the general surface. Gastropores rather large, seldom circular, more often slightly elongated in the direction of the rows, usually with a very irregular outline and rather prominent septa-like internal projections, as though in process of division, unequal and unequally separated, except at the apical parts, where the partitions are very narrow; style very deeply placed, thin and finely hirsute; in section the gastro-canal is found to be papillose. Dactylopores quite minute, irregular, unequally placed, elongated slightly in a transverse direction, nearly even with the surface, except at the extremities, where they are rather elevated and tubular. Ampullæ (apparently female) abundant, scattered or grouped, forming rounded eminences nearly 1 millim. in diameter, marked by straight radial ridges, generally from 5 to 8, which pass from the centre of the ampulla to the outer border, where a circle of rather large

pored openings, closed by thin membranous tissue and placed between the ridges, leads into the single central cavity of the ampulla.

Locality. Raratonga. B.M.

Two specimens of this beautiful form were presented to the national collection by Prof. Flower. I have been enabled to describe this species through the courtesy of Prof. Charles Stewart, who first remarked its specific distinctness.

A very fine specimen in the museum of the Royal College of Surgeons agrees most closely, except in the characters of its ampullæ, with this species. These ampullæ are raised and confluent, the individual ampulla being undistinguishable in the mass. Their surface is covered by the conical markings characteristic of the cœnosteum, and is irregularly and rather sparsely pored with minute openings. This form of the ampullæ is constant throughout the stock, while that described for the species is constant on the two stocks in the British Museum. I am strongly inclined to think that these confluent ampullate swellings are the forms characteristic of the later stages of the ampullæ of the male stocks, which in the earlier stages are sunk beneath the surface of the cœnosteum. This seems to me borne out by the fact that in a large series of specimens of *D. violacea* in the national collection the two forms of the ampullæ are present—the one with the stelliform much swollen eminences, which, though grouped together, are distinct from each other, and are bounded by an outer circle of pored openings; the other with smaller swellings, in which separate ampullæ are seldom distinguishable, and having scattered minute pores over the surface.

This species, though close to *D. granulosa*, differs from it in many particulars, of which the crowded corymbed mode of growth, the coloration, the smaller and more slender habit, the nature of the surface, the arrangement of its cyclosystems, and the size, position, and form of its dactylopores and gastropores may be cited.

Distichopora Milesii, Quelch.

D. Milesii may be separated from both of the foregoing species by its very slender regularly flabellate cœnosteum; by the minutely granulated or smooth surface, which is rendered rough and uneven only by the irregular and abundantly developed ampullæ; by its dull lake-red or almost crimson colour; by the very distinct, wide, deep, continuous lateral

furrows, about 1 millim. in diameter from the extreme outer edges of the dactylopores; by the very large gastropores slightly elongated in the direction of the furrow; by the very small dactylopores which are placed on the distinctly raised ridge of the furrow but above which the separate dactylopores are but slightly prominent except at the apical parts; by the papillose gastro-canal; and by the smooth outer surface of the massed ampullæ which are neither roughened by ridges nor lined by regularly-arranged pored openings.

Distichopora coccinea, Gray.

D. coccinea may be distinguished by its flabellate cœnosteum with much compressed branches and branchlets, crowded on their faces with numerous short often tuberculate young branchlets, which at first are perpendicular to the general plane of the cœnosteum; by its dull crimson-red colour; by its smooth surface; by the small and shallow but distinct lateral furrow; by the small gastropores which lead into a smooth canal and are separated by rather wide partitions; by the very minute dactylopores which are not raised above the general surface and which are separated by distances generally greater than their own diameter; and by the distinctly raised ampullæ which are smooth on their upper surface and are surrounded at their base by a circle of comparatively large pored openings which lead to the central cavity and which are separated by septiform partitions passing to neighbouring ampullæ or to the surrounding cœnenchyma.

Distichopora rosea, Kent.

D. rosea is distinguished by its irregularly flabellate cœnosteum with rounded, thick, obtuse branches and branchlets; by its smooth surface which becomes slightly granulated with obtuse conical eminences towards the apical parts; by its deep peach-blossom red colour; by its extremely wide, deep, distinct lateral furrows which are interrupted at the angle of branching; by its comparatively small unequal gastropores, unequally and often widely separated; by the obsoletely papillose gastro-canal; by the extremely large dactylopores (easily distinguishable by the naked eye), the inner margin failing, so that the pore opens into the furrow while the outer and lateral margins are much elevated and thickened; and by the ampullæ, which are undistinguishably massed together in large raised groups with minute pored openings scattered over the irregularly granulated upper surface.

Distichopora breviserialis, Quelch.

D. breviserialis is distinguished by its irregularly flabellate cœnosteum, with short, thick, obtuse branches and branchlets, the branches being much compressed at the base, rounded above, and often coalescent; by its pale aurora-red or deep flesh-red colour; by its granulated surface, the small conical granules being much enlarged and more prominent at the distal parts; by the obliteration of the pore-rows, except at the apical parts of the branches and branchlets and at the parts of the cœnosteum where fresh branchlets originate; by the rather small unequal gastropores, which are placed in an irregular line at the bottom of a shallow furrow at the apical parts, and which gradually diminish and disappear by overgrowth; by the nearly smooth gastro-canal; by the small dactylopores, which are placed on the edges of the shallow furrow at the extremities, but which become gradually even with the surface, and finally are obliterated; and by the ampullæ, which are often grouped together, and consist of a raised central portion which is marked on its upper surface with small, more or less radial, rather sharp ridges, and is surrounded by a circle of comparatively large pored openings, which are separated by thick septiform partitions with which the ridges are continuous, passing to neighbouring ampullæ or to the surrounding cœnenchyma; in the later stages of these ampullæ, when the central portions break away, the group presents the appearance of a rough mass with irregular pores, in which the single central cavities of the ampullæ are hardly distinguishable from the surrounding openings which lead to them.

Distichopora gracilis, Dana.

D. gracilis is distinguished by its regularly flabellate and extremely slender habit; by its fainter or reddish coloration; and by its compressed branches; but a more complete description of the type specimen of this little-known species is required, since little or nothing is known as to the nature of its cœnenchyma, its surface, its cyclosystems, and its ampullæ.

Distichopora nitida, Verrill.

D. nitida is distinguished by its large regularly flabelliform habit; by its rounded branches, somewhat compressed at the base; by its rounded obtuse branchlets, expanded at the tips during division; by its extremely variable coloration, ranging

from bright red to light orange; by its minutely granular surface, becoming almost smooth at the basal parts; by its obsolete or very shallow lateral furrows, the partitions between the gastropores being generally raised to the surrounding surface; by the unequal large gastropores; by the minute superficial dactylopores; and by the scattered or grouped raised granulated ampullæ, in which the pores communicating with the central cavity are arranged in a circle around the base, the septiform partitions between them passing off to the surrounding cœnenchyma or to neighbouring ampullæ.

Distichopora ochracea, n. sp. (Pl. I. fig. 2.)

Cœnosteum branching in a plane, of a dull ochre-yellow colour, sometimes becoming white at the tips; branches thick, rounded, or slightly flattened; branchlets short and rather thick, rounded, obtuse, expanded at the tips before division takes place. Cœnenchyma rather firm; surface minutely granular at the basal parts of the branchlets, becoming more granulated at the extremities, with crowded, very obtusely conical eminences, between which are scattered pores. Cyclosystems regularly arranged in continuous, wide, shallow lateral furrows. Gastropores irregularly placed, unequal, but generally very large, circular or elongated transversely, separated by very narrow partitions, which are often raised to the general surface; gastro-canal very crowdedly papillose; style very deeply placed, slender, and finely hirsute. Dactylopores very unequal, some rather large, others very minute, elongated transversely, the outer and lateral margins scarcely or not at all raised, except at the extremities of the branchlets, where the inner margin is continuous with the rounded edge of the furrow, along which the dactylopores are closely placed. Ampullæ scattered or grouped, consisting of rounded eminences with slightly developed subradial ridges on the central portion, surrounded at the base by a circle of pored openings which communicate with the single central cavity and which are separated by septiform partitions passing off to neighbouring ampullæ or to the surrounding cœnenchyma.

Locality. Solomon Islands, 14 fath. B.M.

This species is founded on a small piece of a cœnosteum which was dredged by H. B. Guppy, Esq., M.B., R.N., Surgeon to H.M.S. 'Lark,' and by him presented to the national collection. It is very distinct from all known species of the genus, being most closely related to the *D. nitida*, Verrill.

EXPLANATION OF THE PLATES.

Plate I.

Fig. 1. *Distichopora granulosa,* natural size, showing ampullæ.
Fig. 1 *a.* Ditto: pore-rows, magnified.
Fig. 1 *b.* Ditto: dactylopores, with ridges of the surface, seen laterally, magnified.
Fig. 1 *c.* Ditto: ampulla, magnified.
Fig. 2. *Distichopora ochracea,* natural size, showing ampullæ.
Fig. 2 *a.* Ditto: pore-rows, magnified.
Fig. 2 *b.* Ditto: ampulla, magnified.
Fig. 2 *c.* Ditto: gastro-canal in section, magnified.
Fig. 3. *Distichopora conferta,* natural size, showing ampullæ.
Fig. 3 *a.* Ditto: pore-rows and part of surface, magnified.
Fig. 3 *b.* Ditto: ampulla, magnified.
Fig. 4. *Zygophylax profunda*: portion of hydrophyton, natural size.
Fig. 4 *a.* Ditto: branch, magnified.
Fig. 4 *b.* Ditto: hydrotheca and nematophore of one side, magnified.
Fig. 4 *c.* Ditto: part of fascicled stem, magnified.
Fig. 5. *Streptocaulus pulcherrimus*: proximal part of stem, magnified.
Fig. 5 *a.* Ditto: reproductive appendage with gonothecæ, magnified.
Fig. 5 *b.* Ditto: gonotheca, magnified.

Plate II.

Fig. 1. *Cryptolaria conferta*: part of stem with gonotheca, magnified.
Fig. 2. *Plumularia variabilis*: part of stem with pinna and gonotheca, magnified.
Fig. 2 *a.* Ditto: part of another pinna, magnified.
Fig. 3. *Plumularia delicatula*: portion of stem with gonotheca and pinnæ, magnified.
Fig. 4. *Antennularia irregularis*: stem, showing arrangement of ramuli.
Fig. 4 *a.* Ditto: part of stem with ramuli, magnified.
Fig. 4 *b.* Ditto: gonotheca, magnified.
Fig. 5. *Antennularia profunda*: stem, showing arrangement of branches and ramuli.
Fig. 5 *a.* Ditto: portion of stem, proximal part, magnified.
Fig. 5 *b.* Ditto: portion of stem, distal part, magnified.
Fig. 5 *c.* Ditto: portion of ramulus, magnified.

II.—*Notes to the Australian Sponges recently described by Carter**. By Dr. R. v. Lendenfeld, in Sydney.

As I am just now engaged in writing a Monograph of the Australian Sponges I was particularly glad to receive the

* H. J. Carter, "Description of Sponges from the Neighbourhood of Port Phillip Heads, South Australia," Ann. & Mag. Nat. Hist. ser. 5, vol. xv. p. 196.

publications on the subject by Carter, through the courtesy of the author.

There are, in the part concerning the Ceraospongiæ and Myxospongiæ, no figures, and the diagnoses are so short that it is, in by far the greater number of species, impossible for me to identify them with those in my collection, or to ascertain those characteristics which I consider as the most important.

There are a few, however, which, in consequence of some accessory peculiarity or other, I have been able to recognize. My collection of several thousand specimens of Australian Sponges is by far the finest as yet brought together from any one locality, and I think that not only Carter, but also all other scientists who are working at the Sponges, will be interested in the result of a comparison between Carter's diagnoses and the specimens in my collection.

*Halisarca australiensis** is not a sponge at all, but the crusts described by Carter under the above name are the ova of *Boltenias* surrounded by their folliculi. I myself believed that the slimy coatings in question were perhaps sponges, and I examined them accordingly. The results of this examination are laid down in a paper published by me last year†.

The *Boltenia* is probably *Boltenia australis*. The name *Boltenia australiensis* given by Carter‡ is not warranted.

Chondrilla uncula, O. S., is mentioned as occurring in Port Phillip §. I have not found any specimens of this sponge on any part of the Australian coast. I have, however, described a species of *Chondrilla* as *C. secunda*, n. sp., from Port Phillip, in a paper read some time ago before the Linnean Society of N. S. W. ||, which is somewhat different from *C. uncula*, O. S., in the shape of its spicules and particularly the configuration of the canal-system, but which outwardly appears very similar to the Adriatic species, of which I brought a specimen with me. I think it very probable that Carter's specimen is to be referred to my *Chondrilla secunda*, a sponge very abundant in Port Phillip.

* H. J. Carter, "Description of Sponges from the Neighbourhood of Port Phillip Heads, South Australia," Ann. & Mag. Nat. Hist. ser. 5, vol. xv. p. 197.

† R. v. Lendenfeld, "On the Slimy Coatings of certain Boltenias in Port Jackson," Proc. Linn. Soc. N. S. W. vol. ix. p. 495.

‡ H. J. Carter, *l. c.* p. 197.

§ H. J. Carter, *l. c.* p. 200.

|| R. v. Lendenfeld, "A Monograph of the Australian Sponges," Abstracts of Proc. Linn. Soc. for January 1885.

*Luffaria digitata** is very meagrely described, but I think it highly probable that it is identical with a sponge described eighteen years ago by Selenka † as *Spongilia cactos*, and which has been investigated by F. E. Schulze ‡ and myself §. Carter has, apparently, not seen my paper on Sponges of Port Phillip, otherwise I think that my description of this sponge would have been sufficient for identification. I have named it *Dendrilla rosea*, which name, having priority, ought to replace the name *Luffaria digitata* given by Carter ‖. The most important feature of the sponge is its peculiar subdermal cavity. Carter does not mention this; but as he does not say anything about the canal-system at all, it is probable that he never examined any section-series.

Darwinella australiensis ¶ is represented in my collection, but the canal-system is not described by Carter, so that it is difficult to identify the species.

With *Aplysina lævis*** of Carter, seven distinct species in my collection might be identified. These are very different from one another, but all coincide with Carter's diagnosis of the above species. They are forms which lead to the Dysideidæ of Marshall ††, of which Carter's *Pseudoceratina durissima* ‡‡ may be a true representative.

The diagnosis given by Carter of *Aplysina purpurea* §§ led me to believe that it might be identical with a sponge examined by me and named *Aplysilla violacea* ‖‖; but now it

* H. J. Carter, "Description of Sponges from the Neighbourhood of Port Phillip Heads, South Australia," Ann. & Mag. Nat. Hist. ser. 5, vol. xv. p. 201.

† E. Selenka, "Ueber neue Schwämme aus der Süd-See," Zeitschrift für wissenschaftliche Zoologie, Band xvii. Seite 566, Tafel xxxv. fig. 5.

‡ F. E. Schulze, "Untersuchungen über den Bau und die Entwickelung der Spongien," Zeitschrift für wissenschaftliche Zoologie, Band xxx. Seite 379.

§ R. v. Lendenfeld, "Ueber Cœlenteraten der Süd-See.—II. Neue Aplysinidæ," Zeitschrift für wissenschaftliche Zoologie, Band xxxviii. Seite 271 ff.

‖ H. J. Carter, *l. c.* p. 201.

¶ H. J. Carter, *l. c.* p. 203.

** H. J. Carter, *l. c.* p. 204.

†† William Marshall, "Ueber Dysididen und Phoriospongien," Zeitschrift für wissenschaftliche Zoologie, Band xxxv. Seite 92.

‡‡ H. J. Carter, *l. c.* p. 204.

§§ H. J. Carter, "Contributions to our Knowledge of the Spongida.—Order II. Ceratina," Ann. & Mag. Nat. Hist. ser. 5, vol. viii. pp. 103–105.

‖‖ R. v. Lendenfeld, *l. c.* Seite 237 ff.

seems that this is not the case, as Carter considers the Australian specimen of that sponge to be identical with his *Pseudoceratina durissima* *.

Carter's new genus *Holopsamma* † is identical with Marshall's genus *Psammopemma* ‡, established five years ago, and the latter name must be accepted accordingly as having priority.

The species described as *H. crassa* § and *H. lævis* || cannot be distinguished. I possess in my collection numerous transition forms between them, and all these ought to be combined under the name given to them previously by Marshall¶, viz. *Psammopemma densum.* I think, however, that I shall be able to distinguish a few species, as the canal-system is not the same in all the specimens I have examined. It is, however, a matter of quite unusual difficulty to make good series of sections through these arenaceous sponges.

Holopsamma laminæfavosa ** may be identical with Marshall's genus *Psammodema* ††.

Both *Holopsamma fuliginosa* ‡‡ and *H. turbo* §§ are unrecognizable.

The establishment of a new genus *Sarcocornea* |||| for a dry *Dysidea* is not justified. In the diagnosis there is nothing by which the only species could be distinguished from *Dysidea.*

Dysidea fragilis, Johnston ¶¶, and *Dysidea Kirkii*, Bowerbank***, are mentioned. I only possess the latter in my collection. Chaliniform species are very abundant, and I possess long series of continuous transition-forms. I believe this shape to be a mimicry of the true Chalinidæ, which, in consequence of their axial spicules, would not be very digestible food.

I cannot say anything about the species described as *Dysidea hirciniformis* ††† and *chaliniformis* ‡‡‡. The descrip-

* H. J. Carter, "Description of Sponges from the Neighbourhood of Port Phillip Heads, South Australia," Ann. & Mag. Nat. Hist. ser. 5, vol. xv. p. 205.

† H. J. Carter, *l. c.* 211.

‡ William Marshall, "Ueber Dysididen und Phoriospongien," Zeitschrift für wissenschaftliche Zoologie, Band xxxv. Seite 113.

§ H. J. Carter, *l. c.* p. 211.

|| H. J. Carter, *l. c.* p. 212.

¶ W. Marshall, *l. c.* Seite 113.

** H. J. Carter, *l. c.* p. 212.

†† W. Marshall, *l. c.* Seite 109.

‡‡ H. J. Carter, *l. c.* p. 213.

§§ H. J. Carter, *l. c.* p. 213.

|||| H. J. Carter, *l. c.* p. 214.

¶¶ H. J. Carter, *l. c.* p. 215.

*** H. J. Carter, *l. c.* p. 216.

††† H. J. Carter, *l. c.* p 217.

‡‡‡ H. J. Carter, *l. c.* p. 217.

tions are so short that it is simply impossible to make any use of them.

I consider the genus *Dysidea* as characterized by the following points:—

1. Transparent hyolin. Mesoderm without foreign bodies in the ground-substance.
2. The canal-system and ciliated chambers of *Spongelia* as described by Schulze*.
3. Foreign bodies forming all the fibres.

It cannot of course be decided by the description whether Carter's specimens belong to the genus *Dysidea* in this sense or not.

The sponge described by Carter as *Spongelia stellidermata*† is probably identical with some specimens in my collection, which, however, do not belong to the genus *Spongelia*, but to another family‡, that of the Spongidæ. I have named this sponge *Cacospongia gracilis* §; but it may appear necessary to establish a new genus for it. At all events it does not belong to the genus *Spongelia*, Schulze, who was the first to establish a diagnosis on a really reliable and scientific basis ‖.

Carteriospongia caliciformis¶ is described from a dry specimen, so that no opinion can be hazarded on its real position in the system.

As the configuration of the canal-system is not described and the microscopic structure of the soft parts generally hardly referred to, and as these are considered all important by me, it is only natural that I should not be able to utilize Carter's essay. Just as it was necessary that O. Schmidt should com-

* F. E. Schulze, "Untersuchungen über den Bau und die Entwicklung der Spongien: Die Gattung *Spongelia*," Zeitschrift für wissenschaftliche Zoologie, Band xxxii. Seite 117 ff.

† H. J. Carter, "Description of Sponges from the Neighbourhood of Port Phillip Heads, South Australia," Ann. & Mag. Nat. Hist. ser. 5, vol. xv. p. 219.

‡ J. Vosmaer, "Studies on Sponges.—I." Mittheilungen der zoologischen Station in Neapel, Band iv. Seite 445. Vosmaer's classification is identical with mine, which I arrived at independently, and which is therefore very likely to be correct.

§ In 1883 I identified the sponges from several museums, and I supplied several with names, the diagnoses of which remained in schedule. The sponges referred to can be seen in the museum of the South Australian Institute at Adelaide.

‖ F. E. Schulze, *l. c.*

¶ H. J. Carter, *l. c.* p. 221.

pare Bowerbank's species with his own, I find it advantageous to review Carter's essay from my point of view, so that in the future any one may be enabled to make use of it.

For any one who holds views similar to those of Polejaeff, Vosmaer, and myself, this review will be most welcome, as I, in possession of extensive collections and working the subject on the spot, am best able to judge.

III.—*On the* Teredo utriculus *of Gmelin, with Remarks upon other Ship-worms.* By SYLVANUS HANLEY, F.L.S. &c.

UNTIL lately this ancient species, founded upon a well-executed drawing in Kämmerer (Conch. Cab. Rudolst. t. i.), was omitted, or neglected, in our lists of sea-shells. Of late it has been cited as a synonym of the *T. norvagicus* of Spengler, a conclusion which my recent examination of a most magnificent group acquired by me at Cannes from the wreck of a submerged Italian ship does not confirm. It may, indeed, be a variety, yet with differences in tube, valves, and pallets so perceptible that the untrained eye (I mean as to shells) of a portrait-painter immediately indicated them. I may remark that the *Fistulana corniformis* of Lamarck (as pictorially defined by a reference to Favanne) seems identical; the tube, at least, is closed at the broader end by a dome-shaped covering (as in the genus *Septaria*, =*Kuphus*), which with the bar-like stricture at the narrower extremity are the principal features exhibited in Kämmerer's plate. The pallets are more leaf-like and with shorter stalks than in *norvagicus*, the tube (besides its dome, which some say is present, although I have not myself found it) in all adult members of the genus is more fragile, and the thin valves easily distinguishable by their outline, the fang or central portion being broader and much shorter in proportion than in the solid dark-skinned northern shell to which it has been affiliated. The most striking character, however, is the large space occupied by the finely sculptured triangular area, which descends far down the broad fang.

The species (or variety, if you will) is a southern form; but I obtained many young specimens (valves only) from Guernsey, an outlying province of the Mediterranean fauna,

which I cannot distinguish. The more prominent features seem the peculiar thinness of the valves, whose swollen triangular area is so large as to occupy one half the entire length (hence the fang seems peculiarly short).

During the last twenty years four principal monographic lists of the Teredines have been published by Jeffreys, Fischer, Tryon, and Sowerby. The last, the only one which has been illustrated, and consequently the only one which will enable the mass of collectors to determine their specimens, is by Sowerby in his hurried conclusion of Reeve's 'Conchologia Iconica.' Unfortunately he has neglected the many new species (*subericola*, *excavata*, *bipartita*, *spatha* *, *fusticulus*) described by Mr. Jeffreys in the 'Annals and Magazine of Natural History' for 1860; these, although elaborately described, are unknown to me (for want of figures or, perhaps, of examples), as well as to most conchologists; hence illustrations of them would have been generally acceptable.

As my long study of this genus and the possession of a remarkably fine collection of Teredines have enabled me to correct certain errors in the 'Iconica,' and to suggest additional statements, I venture to critically annotate many of the species indicated. In order to obtain absolute certainty as to what the draftsman actually intended, I have carefully looked for the examples declared to have been drawn from specimens in the British Museum, where, although aided by the Curator, I have often failed to discover them.

The sequence here followed is that adopted in the text which accompanies the four and only plates.

T. navalis.—The reference to Sellius, who expressly mentions that he uses the term "*Teredo marina*" † generically, should be pl. ii. figs. 2, 3, 6; to Spengler, Skriv. Nat. Selskab. vol. ii. pt. 1, p. 103, pl. ii. fig. C.

T. norvagica.—The reference to Spengler's monograph should be pl. ii. figs. 4, 5, 6; to *T. nigra*, Blainville, Diction. Sc. Nat. vol. lii. p. 267, as in 'Quarterly Review,' pl. i. fig. 20, *a*, *b*. *T. navium* of Sellius had better have been omitted, for although that author classed all the ship-worms known to him as *Teredomarina* (a compound generic name), he has copied (?) a bud-shaped pallet, which he regarded as

* Pallets in British Museum, *teste* Jeffreys.

† *Teredo* means a borer; the adjective *marina* is used to distinguish the salt-water worm from *Teredo vestium*, the larva of the clothes moth. Hence it is logically absurd to claim precedence for it.

the *T. navium* of Vallisnieri; judging from the figure that pallet has a shorter stalk and is more tapering at the broader end than is customary in this species.

T. bipennata.—This is *not* the shell delineated in Turton's 'Conchological Dictionary' (figs. 28, 40). The valves look like those of the erroneous *navalis* of Spengler (Skriv. Nat. Selskab. vol. ii. pt. 1, pl. ii.), the pallets of which (perhaps they are worn) seem unlike any of those figured in the 'Iconica,' and remind one of the original drawing of the lost *palmulata*. The two pallets delineated in the 'Iconica' surely belong to two different species, the short-stalked one possibly to Gray's *carinata*. I could not find them in the British Museum, as stated in the text. Mr. Edgar Smith assures me that he can find no shell there under this name which agrees with fig. 3, *a*, or any two dissimilar pallets like those represented by fig. 3, *b*.

T. Stutchburii.—The truncated pallet seems broken, yet is not so really. As Blainville (Dict. Sci. Nat. vol. xxxii. p. 268) professedly described this shell from a manuscript species of Leach's, which formed part of our national collection, it may reasonably be supposed that the identification is correct; yet Blainville asserts that the pallet tapers* rapidly from the first joint to the last, which is not the case in the specimen marked as Leach's type, nor in the figure supposed to represent it.

T. carinata.—This shell was no manuscript species as supposed. The name was published by Gray as that of a new species, and by Blainville, as of Leach's manuscript, almost contemporaneously. Gray's monograph appeared in Taylor's 'Philosophical Magazine' for December 1827 (p. 411, copied in Hanley's 'Recent Bivalves,' p. 4); the volume (lii.) of the 'Dictionnaire des Sciences Naturelles' bears date 1828; both authors described from an example in the British Museum, presumably the same as that roughly delineated by Sowerby, who unfortunately represents for it the *Teredo* previously published (1819) by Turton as *T. bipennata* (Conch. Diction. p. 184, figs. 38, 39, 40). But Gray indicates that the base (or stalk) of the pinnately articulated pallet is short, whereas it is represented by both Turton and Sowerby as decidedly long; evidently, then, the *carinata* of Sowerby is not that of

* The drawing is scarcely to be termed a likeness.

Gray, who subsequently referred the forgotten *T. pennatifera* of Blainville (*loc. cit.* p. 269) to Turton's species. The British Museum does not possess the beautiful pallet ascribed to it in the text of the 'Iconica.'

**T. megathorax*, Gould.—In what work? Can the name be a mistake or a misprint for *T. thoracites* of Gould's 'Otia' (from Proc. Bost. vol. vi.), otherwise omitted? It is certainly, however, not the *Calobates thoracites* of Wright in the Linnean Soc. Trans. (vol. xxv. pl. lxiv.), or its ally *C. australis* (ib. figs. 1–5), both of which are here omitted.

T. campanulata, Deshayes.—This supposed manuscript species has been quoted by Tryon—whose monograph evinces a most painstaking research—as the real *Stutchburyi* of Blainville! I could not descry the delineated valves in the British Museum; but Mr. E. Smith writes as follows:—"The figures give a very rough notion of the valves copied. The auricle is both too long and too wide, and in fig. 9, *a*, the anterior area is not sufficiently large."

†*T. Saulii*.—This supposed manuscript species of Professor Wright combines the valves of the *Nausitora Saulii* of Wright (Trans. Linn. Soc. vol. xxv. pl. lxv. figs. 9–15) with the pallets of *Kuphus Mannii* of the same plate (figs. 1–8). Such combinations render identification hopeless to those whose libraries and whose leisure for research are limited.

T. batava.—This is not the shell designed by Spengler (Skriv. Nat. Selskab. vol. ii. pt. 1), whose characteristic figure of a pallet (pl. ii. fig. 3) coincides precisely with that of the *navalis* of the 'Iconica,' and is very different from the one here depicted. Surely the ascribed locality Batavia (which is not

* "Two specimens had been so labelled in the British Museum from the Cumingian collection. The drawings differ in several particulars; the lower or narrow end of the valves (fig. 8, *b*) is much too incurved, and the inferior margin of the anterior area is also too arcuated. In fig. 8, *a*, the auricle is too prominent, and the central portion of the valve too narrow."—E. Smith.

† Mr. Smith writes that, although the drawings are rough and incorrect, yet they are perhaps better than those in the 'Linnean Transactions.' Fig. 10, *a*, seems to him imaginative, for he could not find anything like it in the museum. The tablet indicated Callao, not Callas Bay; the specimens came from Miss Saul (1853), and why Professor Wright ascribed them to Port Phillip, Australia, was unknown to him.

appended to the example delineated) is not an imaginary one, derived from the supposed specific name Batava (Dutch). From a recent publication one learns that the European species still devastates the dykes of Holland.

The valves of the false *batava* are not so unlike those of *utriculus*; the pallets, however, differ from any I possess.

T. affinis and *T. brevis*, from "Mus. Deshayes" (his collection has been purchased intact by the French government for, I think, the Ecole des Mines; it is not in the zoological gallery of the Jardin des Plantes), should be rather "copied from Deshayes's published figure;" probably Deshayes did not possess the shell. It is a frequent error in the 'Iconica' to ascribe to authors the possession of species which they have only borrowed. In some of the earlier volumes indeed the metaphorically stereotyped "Mus. Cuming" was attached to shells lent by myself *.

T. palmulata.—Lamarck so inadequately described this shell from its pallets alone that various members of the section *Xylotrya* have been adjudged its representative. Nevertheless the pictorial definition is fair enough. Adanson in 1759 (Mém. Acad. Paris, pl. ix.) figured three shipworms as the Taret de l'Europe, Taret de Sénégal, and Taret de Pondicherri (figs. 11, 12). From this last almost every figure of *T. palmulata* has been more or less ill copied. I do not find anything like it in the 'Iconica,' and certainly not the one here figured, which is probably the one so named by Thomson as an Irish species; I also, in youthful confidence, had accepted (Brit. Moll.) the same determination. Mr. Jeffreys, who accepted as typical some pallets in the Parisian Museum, from which he says "Lamarck described the species," though that author neither referred (as usual) to the museum nor to his own cabinet for the source of his description, asserts that they somewhat approximate but are distinct from those of *bipennatus*, and thus, indeed, they appear in the original engraving, which displays more than a score of articulations that taper from the first joint to the (brushy?) apex; the stalk only occupies one third of the entire length. These specimens once belonged to Réaumur, and agree with

* As the fate of typical or even figured examples is not unimportant, I may state that very many of those rightly ascribed to "Mus. Metcalfe" and "Mus. Reeve" have passed into the collection of the author, who also purchased all the types described by Benson from Frederic Layard's cabinet.

the characters of Gray's ideal of *T. palmulata* (from a specimen in the British Museum). Blainville, who avowedly derived his description from Adanson's plate, has ascribed to his *T. Stutchburyi** pallets which precisely suit those of Adanson's figure, but says the valves are perceptibly less long than broad, which does not agree with the more equal height and breadth of the valve portrayed in Adanson's memoir. It is possible that the valves and pallet in one case or the other did not belong to the same species. It might save some confusion, if the shell be really a recognizable one, to prefer the earlier Lamarckian appellation of *bipalmulata* (Syst.) †.

In the synonymy of the Sowerbyan *palmulata* appears the name *T. Philippii*, Fischer. This name was first applied by Gray (Ann. & Mag. Nat. Hist. 1851) to Philippi's erroneous ideal of *T. navalis* (En. Mol. Sic. vol. i. pl. i.); but no description was attached to his correction.

T. minima, also annexed as a synonym, was very briefly described, in French only, by Blainville, in his often-mentioned monograph, as having a very long stalk to its pallet.

T. senegalensis.—Blainville, who has given this name to the Taret du Sénégal of Adanson (Mém. Acad. Paris, 1759, pl. ix., and Voy. Sénégal, p. 263, pl. xix.), observes that the pallet is truncated, not "bicornée." As these words did not harmonize with the pronged pallet depicted in the 'Iconica,' I was puzzled, but found on examination of the museum types that the fault lay in the drawing, which, as Mr. E. Smith declares, gives "but the feeblest notion of the processes copied." Adanson's figures, indeed, are so roughly executed that I hardly dare conjecture what they were designed for (*navalis*?, &c.). None of them, however, resemble the equally indefinite species of the 'Iconica.' The difference of outline in the valves of Adanson's three species is not very marked.

T. nucivora.—As the illustrator has stated that he had not seen the pallet, it is a pity that he did not more precisely state

* Mr. Edgar Smith observes that "the only shells in the museum labelled *T. palmulata* were pencilled by Mr. Samuel Stutchbury (a dealer) as coming from Sumatra." He could not find either valves or pallets which would suit the figures in the 'Iconica.'

† I am a little reminded of Adanson's figures by the valve and first joint of the pallet of *T.* (*Xyl.*) *Dunlopi* of Wright (Trans. Linn. Soc. vol. xxiv.), a shell mentioned in Sowerby's monograph.

the source from which he copied it (fig. 17, *c*); the delineated specimen * differs a little from the earlier representations of it, being shorter than in Spengler's drawing (Skriv. Nat. Selsk. vol. ii. pt. 1, pl. ii. fig. D). The statement that the British Museum had furnished the specimens is an error.

T. denticulata.—The reference should have been to Gray in Ann. & Mag. Nat. Hist. 1851, p. 386, where this name is given, without appended description, to the undescribed and supposed erroneous *navalis* of Möller. Naturalists might have been congratulated that this undeterminable shell was at length defined, only unfortunately the jagged tooth-like projection on the side of one of the pallets of the museum specimen (received from Möller, I fancy) seems the result of an injury or malformation. Both sides of the pallet are represented as symmetrically jagged, but this was imaginative. Mr. Edgar Smith remarks that the valves are inaccurately drawn.

In making these comments upon the monograph of a peculiarly difficult genus, I wish expressly to declare that my criticism is solely designed to prevent the perpetuation, or origination, of errors which would spring from a misplaced confidence in the existence of specimens in the national collection.

It is the only illustrated monograph of the genus, the materials for which are too scattered and too rare to be readily accumulated and compared. An abundance of specimens and a fine library are absolutely indispensable to a conscientious naturalist, and even to obtain access to the latter is almost impossible for a scientific conchologist who permanently lives in England. Rich shell-collectors buy costly specimens, yet for names sponge upon the brains of those whose books they refuse to purchase.

* "Mus. Brit. and Sow." "No tube, valves, or pallet like these drawings are in the museum."—Edgar Smith.

IV.—*Report on the Testaceous Mollusca obtained during a Dredging-excursion in the Gulf of Suez in the Months of February and March* 1869. By Robert MacAndrew.—*Republished, with Additions and Corrections, by* Alfred Hands Cooke, M.A., Curator in Zoology, Museum of Zoology and Comparative Anatomy, Cambridge.—Part II.

[Continued from vol. xv. p. 339.]

Shell.	Station.	Distribution.	Remarks.
Conidæ.			
Conus lividus, *Hwass*	One specimen; shallow water, Jubal Is.	Society and Philippine Is. [Bourbon, Ceylon, Polynesia to Sandwich Is., Natal.]	
—— Rüppellii, *Reeve* [nemocanus, *Hwass*].	One specimen; shallow water, Jubal Is.	Red Sea.	A misidentification; the single specimen is a very young shell of *nemocanus*.
—— arenatus, *Hwass*	Frequent; shallow water, Jubal Is.	Ceylon, &c. [Bourbon, Viti Is., Samoa, Cook's Is., N. Caledonia, Loyalty Is., N. Australia.]	
—— abbreviatus, *Nutt.* [miliaris, *Hwass*].	One specimen; shallow water, Jubal Is.	Sandwich Is. [Ceylon, Viti Is., Samoa, Society Is., Marquesas, Japan.]	A worn shell, but easily recognizable; there is no need to assign it to the var. *abbreviatus*.
—— fulgetrum, *Sow.*	One specimen; shallow water, Jubal Is.	Red Sea.	Possibly a mere variety of *miliaris*, Hwass.
—— pusillus, *Chemn.* [ceylanensis, *Hwass*].	Frequent; shallow water, Jubal Is.	Seychelles. [Aden, Ceylon, New Caledonia, N. Australia, Viti Is., Sandwich Is.]	The two species must be united, for the possession of rows of double spots by *pusillus* is not a sufficiently distinguishing characteristic.
—— flavidus, *Lam.*	Four specimens; shallow water, Jubal Is.	Society Is. [Bourbon, Ceylon, Formosa, Polynesia to Sandwich Is.]	
—— tessellatus, *Born*	Not rare (small); shallow water, Jubal Is.	Ceylon, Mauritius. [Polynesia to Sandwich Is.]	
—— virgo, *L.*	One specimen, living; shallow water, Jubal Is.	Ceylon, &c. [Polynesia to Sandwich Is.]	
—— lineatus, *Chem.*	One specimen, living, large;	Ceylon, Philippines. [New Cale-	

	shallow water, Jubal Is.	donia, Loyalty Is., New Ireland, N. Australia.]	
—— malaccanus ?, *Hwass*	One specimen, dead; shallow water, Jubal Is.	Malacca.	Certainly not *malaccanus*, but probably a well-marked var. of *furvus*, Reeve. There is nothing at the Brit. Mus. that exactly corresponds to it.
—— nemocanus, *Hwass* ..	One specimen, living; shallow water, Jubal Is.	Pacific, Mauritius.	
—— sumatrensis, *Lam.* ..	Two specimens, living; shallow water, Jubal Is.	Sumatra.	
—— Adansoni, *Lam.* [achatinus, *L.*].	Three specimens, shallow water, Jubal Is.	Australia. [Ceylon.]	Better identified with *achatinus*, L.; they correspond exactly with Reeve's fig. 191 *a*.
—— erythræensis, *Beck* [tessellatus, *Born*].	One specimen, living; shallow water, Jubal Is.	Red Sea.	Wrongly identified; the shell is only a young specimen of *tessellatus*.
—— tæniatus, *Hwass*	Abundant; low water, Gaysoom Is.	China Seas.	
—— vicarius, *Lam.* [textile, *L.*].	Shore, dead; not rare, Tur.	Mauritius. [Bourbon, Ceylon, Singapore, Formosa, Japan, New Caledonia, Torres Straits, N.E. Australia, Viti Is., Paumotus.]	
—— nussatella, *L.*	Shore, dead; not rare, Jubal Is.	Society and Philippine Is. [Polynesia to Sandwich Is., N.E. Australia.]	No specimen appears in the collection.
PLEUROTOMIDÆ.			
Turris grandis, *Gray*, var. [tigrina, *Lam.*].	Not rare, 5 fath., Jubal Is.	Indian and Chinese Seas. [Ceylon, Viti Is., Torres Straits, N.E. Australia.]	A misidentification; the shells are clearly specimens of the variable *tigrina*, Lam.
—— cingulifera, *Lam.*	Frequent, 5 fath., Jubal Is.	Philippines, &c. [Ceylon.]	
—— abbreviata, *Reeve* [erythræa, *Jickeli*].	Frequent, 5 fath., Jubal Is.	Philippines, &c.	Wrongly identified; the shells are *erythræa*, Jickeli, which is related to *cingulifera*, but its smaller size, much stumpier form, and rosy instead of brick-red columella and throat of canal, are sufficiently distinctive.
—— monilifera, *Pease*	Not rare, 5 fath., Jubal Is.	Sandwich Is.	Tryon (Man. Conch. vi. p. 173) recklessly

Shell.	Station.	Distribution.	Remarks.
			unites the species with *gemmata*, Hinds, from which it is absolutely distinct, as a glance at the types in the Brit. Mus. shows.
Turris brevicaudata, *Reeve*	Not rare, 5 fath., Jubal Is.	Philippines.	
—— violacea, *Hinds*	Not rare, 10–20 fath., sand.	New Guinea, Philippines, &c. [Persian Gulf, Japan.]	The shells correspond exactly to a species in the Brit. Mus. given as *vertebrata*, Smith (Ann. & Mag. Nat. Hist. 1875, p. 416), the main difference between which and *violacea* appears to be that the former has but one fold on the columella. Even this distinction, however, on the examination of a number of specimens, will not hold; and when it is remembered that *violacea* has a very wide range of distribution, it seems probable that *vertebrata*, Smith, and these Red-Sea specimens are no more than a slight local var. of *violacea*.
—— radula, *Hinds*	Five specimens, small var.; 5–10 fath.	Straits of Malacca.	*Surcula inconstans*, E. A. Smith, from the China seas, the type of which is in the Brit. Mus., is quite devoid of characteristic features, and must pass into the synonymy of *radula*.
Drillia flavidula, *Lam.*	Frequent; dead on shore at Suez.	China and Japan.	*Jeffreysii*, Smith (Japan), is a nearly allied form.
—— cagayanensis, *Reeve* [crenularis, *Lam.*].	Not rare; 2–5 fath., sand, Tur to Ras Mahommed.	Philippines.	Wrongly identified; the shells all belong to the following species.
—— crenularis, *Lam.*	One specimen; 2–5 fath., Jubal Is., &c.	Tranquebar.	The shells (seven specimens from the preceding species being included) differ slightly from the type of *crenularis* in that the ribs are prolonged over the middle of the body-whorl towards the base. It appears to me that *Drillia suturalis*, Gray, described in Ann. & Mag. Nat. Hist. 1838,

			p. 39, but never figured, must be added to the synonymy. The specimens in the Brit. Mus. (presumably named from Dr. Gray's type) do not present any characteristic which can constitute a valid difference of species; certainly *Atkinsonii*, Smith (Ann. & Mag. Nat. Hist. 1877), is identical with *crenularis*. Anyhow, the name should be changed, for Tenison-Woods has described a *Drillia Atkinsoni* in Proc. Roy. Soc. Tasm. 1875, p. 142.
—— tessellata, *Hinds* [*Reeve* =formosa, *Reeve*].	Rare, 2–5 fath., Jubal Is.	Straits of Macassar. [Philippines.]	*Tessellata*, Hinds, is quite a different shell. Tryon seems right in regarding *tessellata*, Reeve, as =*formosa*, Reeve; but I cannot follow him in considering the latter a synonym of *læta*, Hinds.
—— vidua, *Reeve*	Rare, 2–5 fath., Jubal Is.	Philippines.	
—— [parva, *Smith*].	Six specimens.	....	This is one of the "two species undetermined;" the other turns out to be young shells of *flavidula*.
Daphnella Cumingii, *Powis*	One specimen, young; 2–5 fath., Jubal Is.	Pacific. [Grimwood's Is., S. Pacific.]	
—— rissoides, *Reeve*	One specimen; 2–5 fath., Jubal Is.	Philippines.	
—— [vincentina, *Crosse*].	[Three specimens.]	[Gulf St. Vincent, Australia, Port Jackson.]	Although not absolutely identical with the specimens of *vincentina* in the Brit. Mus., the shells are sufficiently near to avoid being made into a new species.
Defrancia rubida, *Hinds* ..	One specimen; 2–5 fath., Straits of Jubal.	Philippines, New Guinea, &c.	
—— tritonides, *Reeve*	Three specimens, young; 2–5 fath., Straits of Jubal.	Philippines.	Wrongly identified; the shells are not in the least like *tritonides*. The species is probably new; but as none of the three specimens is mature, I refrain from describing it.
—— mica, *Ph.*	Four specimens; Straits of Jubal.		

Shell.	Station.	Distribution.	Remarks.
Defrancia polynesiensis, *Reeve*.	Two [five] specimens; Straits of Jubal.	Lord Hood's Is.	
—— [subgranosa, *Smith*].	[One specimen.]	....	This and the following species are from the "twenty-six species undetermined." In reality the number of unidentified species falls far below this; many of the shells are very minute and in bad condition, which doubtless prevents a considerable portion of them from being identified with preceding species in this list.
—— [tenuilirata, *Angas*]..	[Eight specimens.]	[Port Jackson.]	
Mangilia rhomboides, *Lam.*	Not rare.	Philippines.	
—— [Horneana, *Smith*] ..	[Two specimens.]	....	Ann. & Mag. Nat. Hist. 1884, xiv. p. 323.
—— [pura, *Reeve*]	[Six specimens.]		
—— [pyramidalis, *Reeve*].	[Seven specimens.]		
—— [spurca, *Hinds*]	[Two specimens.]		
Cythara triticea, *Kien.* [gracilis, *Reeve*; trivittata, *Ad. & Reeve*].	Not rare.	Indian Ocean.	None of the shells thus named correspond to *triticea*, Kien.; the card contains six specimens, three of which are *gracilis*, Reeve, and three *trivittata*, Ad. and Reeve.
—— turricula, *Reeve* [fusiformis, *Reeve*].	Two specimens.	Philippines.	Another misidentification; the shells are both *fusiformis*, Reeve; *turricula* is quite distinct. To the synonymy of *fusiformis* add *elegans*, Reeve.
—— capillacea, *Reeve* [trivittata, *Ad. & Reeve*].	Five specimens.	Philippines.	Wrong again; they are only young specimens of *trivittata*.
—— [gracilis, *Reeve*].	[Two more specimens.]	....	This and the two following are from the "nine species, undetermined," to which the remark under *Defr. subgranosa* also applies.
—— [seychellarum, *Smith*]	[Two specimens.]	[Seychelles.]	This beautiful species was described in Ann. & Mag. Nat. Hist. 1884, xiv. p. 328.
—— [Waterhousei, *Smith*]	[Two specimens.]		

NATICIDÆ.			
Natica asellus, *Reeve*	Not rare; shore, Ras Mahommed.	Australia.	
—— marmorata, *H. Ad.*..	*Fide* H. Adams, 2–5 fath., sand. Mörch questions the species being identical.	Canary Is. (*R. M.*).	In my opinion there can be no question as to the absolute identity of the Suez shells with H. Adams's *marmorata* (described in P. Z. S. 1879, p. 274), and I make this assertion with the more confidence because the types of *marmorata* are now in this museum. The identification is a very remarkable one, because, so far as we know at present, *marmorata* does not inhabit the Mediterranean. It will probably be discovered there. The shell is a true *Natica*, having (Adams does not mention this) a stony operculum.
—— maroccana, *Chemn.* ..	Frequent, shore to 5 fath., sand.	Canary Is., Pacific, &c. [Sandwich Is., Cape York, Mazatlan, Panama.]	
—— melanostoma, *Lam.*..	Not common; shore, dead, Ras Mahommed.	Seychelle Is. [Bourbon.]	
—— simiæ, *Chemn.*......	Rare; shore, dead, Ras Mahommed.	Philippines. [Bourbon.]	
—— Cumingiana, *Reeve* [*Récl.* = rufa, *Lam.*].	Rare; shore, dead, Ras Mahommed.	Philippines.	I am unable to draw any definite line of separation between the three species *Cumingiana*, Récl. (P. Z. S. 1843), *Powisiana*, Récl. (*ib.*), and *rufa*, Born (Lam.). The supposed differences between them appear to rest mainly on the variations in the pale encircling bands, sutural or otherwise. Récluz himself confesses (P. Z. S. 1843, p. 211) that *Cumingiana* is *valdè affinis* to *Powisiana*.
—— mamilla, *Lam.*	Moderate; shore, dead, Ras Mahommed.	Philippines.	I must confess my inability to see any valid specific distinction between this species and *albula*, Récl., and *pyriformis*, Récl. The author of the two latter was an in-

Shell.	Station.	Distribution.	Remarks.
			veterate species-maker (see the remarks on the last shell), and they may well be united with the widely-distributed and therefore probably somewhat variable *mamilla* of Lamarck.
Natica Lamarckiana, *Récl.* [papilla, *Gmel.*].	Rare; shore, dead, Ras Mahommed.	[Tranquebar, Philippines.]	There is some mistake in the labelling of this species, which is the common *Naticina papilla* of Gmelin.
Lamellaria *minuta, *H. Ad.*	Rare.		
NERITOPSIDÆ.			
Neritopsis radula, *L.*	Five specimens, on shore, dead.	Philippines. [Bourbon, New Caledonia.]	Not in the collection.
Vanikoro rugata, *A. Ad.* ..	Not unfrequent on shore, Zeite Point, Tur, &c.	Réunion.	
—— [acuta, *Récl.*].	Not unfrequent on shore, Zeite Point.	[Lord Hood's Island.] Ceylon.	
PYRAMIDELLIDÆ.			
Pyramidella gracilis, *A. Ad.*	Rare, 12–20 fath., sand.	Philippines. [Japan.]	
—— corrugata, *Lam.*	Moderately rare; 4 fath.	Mauritius. [Sandwich Is.]	
—— mitralis, *A. Ad.*	Not rare; 4 fath.	Philippines.	
—— subulata, *A. Ad.* ..	Rare; 12–20 fath.	Philippines.	The specimens are very fresh and of a light rose-colour.
Obeliscus pusillus, *A. Ad.* [balteatus, *A. Ad.*].	Rare.	Philippines.	There are only two specimens, belonging to two distinct species. One appears to be *balteatus*, A. Ad.; the other is too worn to make out, but it is not *pusillus*.
—— pusillus, *A. Ad.*	....	....	This card is rightly named.
—— sulcatus, *A. Ad.*	Frequent; 2–5 fath.	Tahiti.	

—— Kieneri, *Issel* [terebelloides, *A. Ad.*].	Six [five] specimens, 2–5 fath.	....	Five of the shells are *Obel. terebelloides*, A. Ad. Whether the species *Kieneri*, Issel, which is the *Pyr. gracilis* of Kiener, not of Brocchi, is a synonym of *terebelloides*, Ad., I cannot say. The sixth shell is a young specimen of quite a different species.
—— tessellatus, *Müll.* [*A. Ad.*].	Not rare; 2–5 fath.	Is. of Masbate.	A very marked variety of *tessellatus*. Out of about fifteen specimens only one shows any sign of the characteristic regular belts of dots; these shells are much more solid, last whorl not at all tumid, colour dashes of fawn and chestnut.
—— vitreus, *A. Ad.* [balteatus, *A. Ad.*].	One specimen.	Japan. [Mindanao.]	The shell appears to be *balteatus*, A. Ad.
Syrnola pulchella, *A. Ad.*	Rare.	Japan.	
—— aclis, *A. Ad.*	Three specimens.	Philippines.	
—— aciculata, *A. Ad.*....	Rare.	Philippines and Japan, *PersianGulf.	
—— lucida, *A. Ad.*	One specimen, n. sp.		
—— pupina, *A. Ad.*	Two specimens.	Japan.	
—— subulina, *A. Ad.* [cinctella, *A. Ad.*].	One specimen.	Japan. [Corea Strait.]	The shell is distinct from *subulina*, and is to be identified with *cinctella*, A. Ad.
Ovina pinguicula, *A. Ad.*	One specimen, n. g.	....	Described, together with all the other new species of A. Adams in this paper, in Ann. & Mag. Nat. Hist. 1870, pp. 126–128.
Agatha vitrea, *A. Ad.* ..	One specimen, n. sp.		
Turbonilla bifasciata, *A. Ad.* [=fusca, *A. Ad.*].	Rare.	China. [Japan, S. Australia.]	This species must disappear altogether, as it is simply the dead and bleached state of the same shell described by A. Adams as *Chemnitzia fusca*. The latter name will have priority (P. Z. S. 1853, p. 181), *bifasciata* dating from Ann. & Mag. Nat. Hist. 1861. The *fasciæ angustæ pallide rufescentes* there described are simply the remains of the *rufo-fuscus* colour of the shell in its fresh state. *Turbonilla nitida*, Ang. (P. Z. S. 1867, p. 112), is the same

* Species and localities thus labelled are added to the original list in MacAndrew's own handwriting.

Shell.	Station.	Distribution.	Remarks.
			shell. Tenison-Woods (Proc. Roy. Soc. Tasm. March 13, 1877) altered the name *nitida* to *Angasi*, on the ground of preoccupation; *Angasi* therefore must also now disappear. *Hoffmanni*, Angas, is yet another synonym, given by Angas himself (P. Z. S. March 6, 1877, p. 183) as an alteration of *nitida*.
Turbonilla acicularis, *A. Ad.* [?=fusca, *A. Ad.*].	Rare.	Philippines. [Persian Gulf.]	Though given by Adams (P. Z. S. 1853, p. 182) from the Mus. Cuming, I have not been able to discover the type in the Brit. Mus. I will therefore simply record my strong suspicion that the species, which has never been figured, is simply the young form of (*bifasciata*+*fusca*). Certainly the present shells are so, and they are labelled by Adams himself as "*acicularis*, A. Ad."
—— metula, *A. Ad.* [fusca, *A. Ad.*].	Rare.	Japan.	Quite wrongly identified; the shells are simply *fusca*, A. Ad., only in rather a worse condition than those given above as *bifasciata*.
—— candida, *A. Ad.*	Rare.	Philippines.	
—— fusca, *A. Ad.*	Rare. [Not uncommon, as now determined.]	Philippines. [Japan, S. Australia.]	
—— decussata, *A. Ad.* ..	Rare.	China Sea.	Certainly not; but the single specimen is in bad condition, and can hardly be identified.
—— scitula, *A. Ad.*	One specimen.	China Sea.	Certainly not the *Iole* (afterwards *Iolæa*) *scitula* of A. Ad. (Ann. & Mag. Nat. Hist. 1860, v. p. 300); there is no umbilicus, and the interstices between the ribs are transversely, not longitudinally, striated. Possibly new, but not to be described from a single poor specimen.

—— modica, *A. Ad.*	One specimen.	Japan.	I cannot affirm that the identification is correct.
Mormula Macandreæ	Rare, n. sp.	Jubal Is.	Described in Ann. & Mag. Nat. Hist. 1870, vi. p. 127.
Oscilla annulata, *A. Ad.*	Four specimens.	....	Too hastily identified; the shells, when closely looked at, turn out quite distinct from *annulata* and, apparently, from any known species.
Leucotina [Myonia] modesta, *A. Ad.*	Three specimens.	[Philippines.]	
Monoptygma fulva, *A. Ad.* [Myonia amœna, *A. Ad.*]	Three specimens.	[Philippines, Port Jackson.]	Another misidentification; the shells are *Myonia amœna*, A. Ad., from Port Jackson and the Philippines.
Myonia casta, *A. Ad.*	Two specimens.	China Sea.	
Styloptygma lendix, *A. Ad.*	Four specimens.	Japan. [Persian Gulf.]	Correct.
—— nivea, *A. Ad.*	One specimen, n. sp.	... .	Ann. & Mag. Nat. Hist. 1870, vi. p. 126.
Cingulina circinata, *A. Ad.*	Two specimens.	Japan. [Persian Gulf, S. Australia?]	Mr. G. F. Angas (P. Z. S. 1865, p. 169) doubtfully identifies a South-Australian shell with the present form.
Scalenostoma Deshayesii, *A. Ad.*	One specimen, n. sp.	....	The systematic position of the genus is doubtful; Adams himself refers it to the Styliferidæ. The question remains in abeyance until a specimen with a perfect apex is discovered.
Eulima acuta, *A. Ad.*	Rare; 20 fath.	Philippines.	
—— opaca, *Sow.*?	Rare.	....	No specimens now in the collection.
—— subangulata, *Sow.*	Rare.	Indian Ocean.	Exceedingly doubtful; the specimens are in the worst possible condition.
Styliferina callosa, *A. Ad.*	One specimen, n. sp.		
—— goniocheila, *A. Ad.*	One specimen.	Japan. [Persian Gulf.]	Correct.
Niso candidula, *A. Ad.*	One specimen.	Philippines.	Probably only the young of the common *terebellum*; but the shell is in bad condition and small.
CERITHIIDÆ.			
Cerithium adenense, *Sow.*	Five to ten fath.; not rare.	Persian Gulf.	
—— cæruleum, *Sow.*	Low water; frequent.	Red Sea. [Aden.]	
—— bifasciatum, *Sow.*	Low water; dead; five specimens.	Philippines. [Formosa.]	Possibly nothing more than a var. of the variable *morus*, L.

Shell.	Station.	Distribution.	Remarks.
Cerithium gracile, *Pease* [rostratum, *Sow.*].	Low water; dead; two specimens.	[Bourbon.]	The specimens are in poor condition, but may be recognized as young shells of *rostratum*, Sow., the characteristic mouth not yet being developed.
—— dialeucum, *Ph.*	Shallow water; rare.	Philippines.	There are only three broken specimens, and all that can be said of them is that they are certainly not *dialeucum*, Phil. That species (see Abbild. Cerith. pl. i. fig. 5) is only a synonym of the variable *columna*, Sow.
—— erythæense, *Lam.* [=tuberosum, *Fabr.*].	Low water; frequent.	Red Sea.	The correct spelling is *erythræonense* (Lam. An. s. Vert. ed. ii. vol. ix. p. 292); Sowerby gives *erythrænense* wrongly. I shall not be surprised if the species ultimately proves a mere variety of *nodulosum*, Brug. The comparative smallness of size will then be due to degeneracy from the type form, caused by distance from the metropolis of distribution.
—— granulatum, *Forsk.* [rugosum, *Wood*].	Low water; moderate.	Red Sea.	I do not know where *granulatum*, Forsk., was described; but if the identification be correct, it is a mere synonym of *rugosum*, Wood, to which these specimens evidently belong.
—— lacteum, *Kien.*	Shore, dead; rare.	Philippines.	
—— morus, *Lam.*	Shore, one specimen.	Madagascar. Philippines, [Bourbon, Ceylon, Samoa, Natal.]	
—— rarimaculatum, *Sow.*	Shore, dead; rare.	Philippines.	
—— rostratum, *Sow.*	Six fath.; rare.	Philippines.	Reeve's figure gives no idea of the elegance of this shell; MacAndrew has placed some of the specimens in the Brit. Mus.
—— rugosum, *Wood.*	Shallow water; moderate.	Philippines. [Japan, Sandwich Is.]	
—— Rüppelli, *Phil.*	Shore and shallow water; abundant.	Red Sea.	Issel (Malac. del Mar Rosso, sp. 341) has enumerated the synonymy, amongst which

				he curiously places *Cerithium articulatus*(?), as given in Reeve, Conch. Ic. pl. iv. 16. That shell, however, as is well known, is a *Vertagus*, and can have no possible connexion with the present species.
—— scabridum, *Phil.* [Rüppelli, *Phil.*].	Shallow water; moderate.	Red Sea.		Sowerby, in his monograph of the genus (1855), was unable to identify *scabridum*, Phil. Reeve, in the 'Conchologia' (1865), figures for it a shell remarkably like a form of *columna*, Sowerby, and utterly unlike the *scabridum* figured in the 'Abbildungen.' The present specimens, about twenty in number, are without exception young or dwarf forms of *Rüppelli*, Phil., and a careful study of Philippi's description of *scabridum* leads me to the belief that it is nothing more than this, especially as he gives it from the same locality as *Rüppelli*, brought by the same collectors.
—— echinatum, *Sow.* [*Lam.*], [columna, *Sow.*].	Shore, dead; one specimen.	Society Is.		A large specimen of *columna*, Sow.
—— tuberculatum, *L.*, var. [variegatum, *Quoy*].	Shore, dead; moderate.	Philippines.		Wrongly identified; the four specimens are unmistakably *variegatum*, Quoy.
—— turriculum [turritum, *Sow.*].	Rare; 5 fath.	Philippines.	[Andamans.]	A clerical error for *turritum*.
—— columna, *Sow.* ……	Shore and shallow water, several varieties; not rare, Ras Mahommed, &c.	Philippines.	[Samoa, &c.]	To the synonymy of this somewhat variable shell must be added *siphonatum*, Sow., and *munitum*, Sow. Reeve has made a characteristic mistake over this last species. In the 'Conchologia' (vol. xv. *Cerith.* sp. 69) he ascribes the species to Philippi, Enum. Moll. Sicil., and gives the Mediterranean as a locality. On referring to the 'Enumeratio,' however, we find not *munitum* but *minutum*, which is there set down

Shell.	Station.	Distribution.	Remarks.
			as a fossil variety of *vulgatum*, Brug.! Yet Reeve copies Sowerby's figure of *munitum* from the 'Thesaurus,' and inserts a second figure of the shell (69 *b*), which might do for almost any old and worn specimen of the genus. Further synonyms are *dialeucum*, Phil., and *sandvichense*, Sow., while *suturale*, Phil., is a variety marked by a band of colour at the sutures.
Cerithium interstriatum, [*Sow.*	Shallow water; rare.		
—— petrosum, *Wood* [rugosum, *Wood*].	Frequent; low water.	Philippines.	Quite undistinguishable from *rugosum*, Wood, in which species *petrosum* must be merged.
—— moniliferum, *Dufr.*? [*Kien.* =morus, *Lam.*].	Frequent; low water.	Philippines. [Natal.]	Here again the species must be merged in *morus*, from which it is quite undistinguishable. A tablet in the Brit. Mus. from Panay, Phils., labelled "*morus*, var.," has a note on the back, "*moniliferum*, Dufr."
—— variegatum, *Quoy* [morus, *Lam.*].	Shallow water; rare.	Philippines.	The identification of these *Cerithia* has been unfortunate throughout.
—— spathuliferum, *Sow.* . .	Five fath.; rare.	. . . .	The single specimen is only a form of *Rüppellii*, Phil., in which the transverse ribs and nodules are strengthened, while the parallel striæ are evanescent. The species as a whole (there seems only one specimen known) seems merely a large form of *munitum*, Sow., =*columna*, Sow., var.
Vertagus fasciatus, *Brug.*	Two specimens, living; 6 fath., Jubal Is.	Philippines.	The shells correspond exactly to that form of *fasciatus* which is made by Pfeiffer into the separate species *Martinianus*.
—— Kochi, *Phil.*	Frequent; 4-6 fath., Jubal Is.	E. Africa. [Andamans, Philippines, Japan.]	

—— †recurvus, *Sow.*	Frequent; 5–10 fath., Jubal Is.		
Colina contracta, *Sow.*	Shore; rare.	[Natal.]	
Bittium tenue, *Sow.*	Shore; one specimen.	Port Lincoln.	The specimen is in such bad condition that all one can say is that the identification may possibly be correct.
Triphoris corrugata, *Hinds*	Rare; 10–30 fath.	China. [Malacca, New Caledonia, Japan.]	
—— micans, *Hinds*	One specimen; 10–30 fath.	New Guinea.	
—— ornata, *Desh.*	Not rare; 10–30 fath.	W. Indies.	I have not been able to examine the correctness of this identification. If the West Indies be the true locality of the Deshayesian *ornata*, the present is hardly likely to be the same species.

† The shell usually given as *Vertagus recurvus* (Sowerby, 'Genera,' vol. ii. *Cerithium*, p. 20, figs. 16, 17, 18) is quite undistinguishable from *Vertagus Kochi* (Philippi, Zeitschr. für Malakoz. 1848, p. 21, Abbildungen, vol. iii. *Cerithium*, p. 14. fig. 3). The species are kept distinct in the British Museum, but a careful examination of the numerous specimens there displayed renders the distinction untenable. If this were all, the matter would be simple enough. But any one who examines Sowerby's figures of *Cerithium recurvum* cannot fail to be struck with the remarkable dissimilarity between his fig. 18, on the one hand, and his figs. 16 and 17, on the other. Fig. 18, as he tells us in the text, is drawn from a shell in Mr. Hanley's collection, so is fig. 17; fig. 16 is from one of Cuming's shells. Now, through the kindness of Mr. Hanley, who has lent me the types, the actual shells from which Sowerby drew his figs. 18 and 17 are now before me, and they turn out to be two different species! Fig. 18 is the shell usually known as *recurvum*, Sow. (=*Kochi*, Phil.); but the other, the original of fig. 17, is quite distinct from it. And, unfortunately, this latter shell is marked as the type, partly in Sowerby's, partly in Mr. Hanley's writing. It is a poor specimen, with the outer lip partly broken; but from the large series before me I have no hesitation in identifying it as a young form of *Rüppelli*, Phil., the young of which differs considerably from the maturer shells generally seen in collections. Consequently there are two courses open to us: we may either prefer to regard as the type of *recurvum* what is not really the type, viz. Sowerby's fig. 18, in which case *recurvum*, Sow. (1855) =*Kochi*, Phil. (1848), or else identify the real type, as I do, with *Rüppelli*, Phil. (1848, Zeitschr. für Malakoz. p. 22). In either case the name *recurvum* must disappear. I transcribe the more striking parallel points in the descriptions of the two shells.

Cerithium Rüppelli, Phil.

C. testa elongato-turrita, albida, sæpius fusco-punctata, granulato-aspera; granulis subtriserialibus, in anfractu ultimo quinqueserialibus (the number of granulated ribs varies when a number of specimens are examined).

Cerithium recurvum, Sow.

C. testa acuminata, alba, fulvo vel rufo interpunctata, anfractibus duodecim triseriatim granosis, ultimo costellis septem granosis, ornato (Philippi proceeds to speak of "die sechste Reihe kleiner Körner" on the last whorl).

Shell.	Station.	Distribution.	Remarks.
Triphoris rubra, *Hinds* . .	Rare; 10–30 fath.	Sandwich Is., New Ireland. [Bourbon.]	*Formosa*, Desh. (Conch. de l'Ile de Réunion, p. 102), appears to be identical.
—— granulata, *Ad. & Reeve.* —— *crenulata, *Desh.*	Not rare; 10–30 fath. [Four specimens.]	China Sea. [Whydah.] [Bourbon.]	The species appears identical with *æmulans*, Hinds.
Pirenella Caillaudi, *Pot. & Mich.* [mammillata, *Risso*].	Abundant on shore.	Red Sea, Persian Gulf. [Mediterranean, from S. France to Egypt.]	Opinions differ as to whether *conica*, Blainv., is synonymous with *mammillata*, Risso; I have followed in the track of the majority in believing that it is so. The point of importance, however, is that the present shells, described as *Caillaudi*, by Pot. & Mich., are identical with the common Mediterranean brackish-water *Pirenella*, whether it be called *conica* or *mammillata*. Issel (Malac. del Mar. Rosso, p. 150) holds the distinctness of the Suez species; but since the only difference he can bring forward in support of this view is that the Suez species is "more slender and elongated," it is obvious that his case is not a strong one.
—— sp.	Abundant on shore.	. . . .	This species is only a variety of the preceding, in which the sculpture is much more elaborate and the shell as a whole much more finished. It corresponds to the shells in the Brit. Mus. labelled *cinerascens*, Parr., and to "*cinerascente*, Pallas?" in Sowerby's 'Thesaurus,' presenting exactly the bluish porcelain appearance noted there.
Planaxis breviculus, *Desh.* [=sulcatus, *Born*].	Low water; frequent.	[Bourbon, Formosa, Japan, N.E. Australia, Natal.]	From a very careful examination of their respective descriptions, and also of the shells identified as such in the Brit. Mus. and elsewhere, I am led to conclude that

			both *Plan. breviculus*, Desh., and *Savignyi*, Desh., are mere varieties of the common and widely-distributed *sulcatus*, Born. I have no space here to enter into a discussion on the subject, but will simply say that an examination of many specimens shows that the species varies greatly in point of (1) depth of the grooves, (2) number of grooves, (3) smoothness or roughness of surface, (4) coloration. Further, but less important, synonyms are *griseus*, Broc., *Menkeanus*, Dkr., and probably *crassispira*, Smith, a variety of more uniform breadth, to which some of the specimens before me form an easy passage. It will be noticed that Issel gives only *griseus* and *Menkeanus* in his Red-Sea list, identifying *Savignyi* with *griseus*, while Vaillant (Journ. de Conch. 1865, p. 106) records *sulcatus* only as the common Suez species, plainly showing that he regarded, as I do, all these above-mentioned species as reducible to one.
—— Savignyi, *Desh.* [= sulcatus, *Born*].	Low water; frequent.		
—— griseus, *Lam.* [*Brocchi*].	....	....	Lamarck, as Smith has pointed out (A. and M., 1872, ix. p. 37), only knew of two species, *sulcata* and *undulata*, now united.
—— succinctus, *A. Ad.* [punctostriatus, *Smith*].	Low water; rare, dead.	[China seas.]	*P. succinctus* of A. Adams is a West Indian shell, identical with the common *lineatus*, Costa. The present shells were accordingly named in MS. *punctostriatus* by Mr. E. A. Smith, and the type is in the Brit. Mus. Only three specimens exist, all much worn.
VERMETIDÆ.			
Vermetus eruca, *Lam.*	Frequent.	....	This must be the same shell given by Issel

Shell.	Station.	Distribution.	Remarks.
			as *Serpulorbis inopertus*, Leuck.; which identification is correct, or whether the two species are identical, I am unable to say.
SCALARIIDÆ.			
Scalaria Ferussaci, *Aud.* . .	Two specimens.	....	I am not able to guarantee the correctness of this identification.
—— Jomardi, *Aud.* [mindoroensis, *Sow.*].	Seven specimens.	....	The shells are *mindoroensis*, Sow.; whether *Jomardi*, Aud., is a synonym of this I cannot say. Reeve has not identified it in the 'Conchologia.'
—— *aculeata, *Sow.*	*Moderately frequent.	[Malacca, Hongkong, Philippines.]	
—— *lyra, *Sow.*	[Two specimens.]	[Philippines.]	
—— *bullata, *Sow.*	[One specimen, young.]	[Philippines.]	
—— [millecostata, *Pease*].	[One specimen.]	....	A young shell, but I think rightly identified.
TURRITELLIDÆ.			
Turritella torulosa, *Kien.*	Not rare in 12–20 fath.	....	I suspect that *torulosa*, Kien., =*trisulcata*, Lam., but have not been able to settle the question.
—— flammulata, *Kien.* [torulosa, *Kien.*].	Two specimens, in bad condition.	Red Sea.	Certainly not *flammulata*: the ribs are rough with the transverse striæ between and upon them; in *flammulata* the ribs are smooth, the striæ longitudinal; the shells are stained specimens of *torulosa*.
—— *alba, *H. Ad.* [torulosa, *Kien.*].	Two specimens.	....	I do not know the species; but if these shells are correctly identified it is a mere synonym of *torulosa*, Kien., of which these are very young and colourless specimens.
—— *canaliculata, *Ad. & Reeve.*	Fairly common.		

NERITIDÆ.			
Nerita Rumphii, *Récl.* [polita, *L.*, var.].	Not rare; low water.	Philippines. [Aden, Singapore, N.E. Australia, Natal.]	I cannot regard *Rumphii*, Récl., as anything but a well-marked variety of *polita*, L. The present shells, however, do not correspond even to that variety, but are merely a small form of the type, which occurs also commonly at Aden.
—— quadricolor, *Chemn.* [histrio, *L.*].	Low water.	Red Sea. [Philippines, Natal.]	There appears to me no valid difference between this species and *Le Guilloana*, Récl., *chrysostoma*, Récl., *semirugosa*, Récl., and *maura*, Récl., all from the E. Indies, and all described in the Rev. Zool. Soc. Cuvierienne, 1841, p. 102, and 1842, p. 179. Further, they all appear identical with *histrio*, L. Differing from one another in such minor points as coloration, elevation of spire, and stoutness of ribs, these so-called species all agree in their general features, particularly in the characteristic interrupted black and white marking, the shape, number, and position of the teeth, and in the character of the smooth area against the columella. Probably *oleagina*, Reeve, should also take its place as a well-marked variety with a very raised spire and somewhat different colouring.
—— marmorata, *Récl.* [*Reeve*].	Low water; frequent.	....	This species is very largely represented in the collection, there being, with the shells below labelled *sanguinolenta*, Menke, over fifty specimens. I regard *marmorata*, Reeve, as identical with *Yoldi*, Récl. (also from the Red Sea), which name should by rights have the priority, as it was described in 1841, and *marmorata* in 1855. But as the latter name has become the better established, it is perhaps a pity to disturb it. *Nerita haustrum*,

Shell.	Station.	Distribution.	Remarks.
			Reeve, also from the Red Sea, appears synonymous.
Nerita sanguinolenta, *Menke* [=marmorata, *Reeve*].	Low water; not rare.	....	In no respect differing essentially from the preceding species, it is simply a brighter coloured and better sculptured form. Specimens of this very variable species [*marmorata*+*sanguinolenta*] differ widely in texture, doubtless according to their station; the young are thin and sharply ribbed, while very old specimens are exceedingly thick, with a strong callus on the columella, and would not be recognized as the same species without the help of the intermediate forms.
Smaragdia Feuilleti, *Audouin*	Shore to 25 fath.; frequent.	[Philippines, Torres Str.]	*Rangiana*, Récl. (Rev. Zool. Soc. Cuv. 1841), is a synonym, and was originally described as a var. of *viridis* by Rang in Fér. Bull. des Sciences, x. 1827, p. 412. Küster keeps it distinct from *viridis*, admitting it, however, to be "*viridi simillima*." He identifies *Feuilleti* with *viridis*, but not with *Rangiana*.
—— *pulcherrima, *Angas*.	Not unfrequent, 20–30 fath.	*Persian Gulf. [Port Jackson, Cape York.]	*Souverbiana*, Montr., is a synonym.

[To be continued.]

V.—*On* Doratopteryx *of Rogenhofer, a Genus of Moths allied to* Himantopterus. By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

IN my recent description of a new genus—*Pedoptila*, allied to *Himantopterus*—I referred (pp. 340 and 342) to a moth from Zanzibar identified many years since by Herr A. Rogenhofer as a *Himantopterus*, of which, however, no description appeared to have been published.

Herr Rogenhofer has kindly forwarded to me a separate copy of a short paper, published last year in the 'Sitzungsberichten der k. k. zoolog.-botanischen Gesellschaft in Wien' (vol. xxxiii.), in which a description of this moth appears, a new genus, *Doratopteryx*, being erected for its reception. Although, as I expected, this moth comes nearer to *Pedoptila* than to *Himantopterus*, it must stand as a distinct genus between these two.

Doratopteryx, as figured and described by Herr Rogenhofer, differs from *Pedoptila* as follows:—

Doratopteryx.	*Pedoptila.*
Expanse of wings 17 millim.	Expanse of wings 23 millim.
Secondaries 17 millim.	Secondaries $18\frac{1}{2}$ millim.
Costal and subcostal veins of primaries well separated.	Costal and subcostal veins of primaries lying close together.
Subcostal branches separate at their origins.	Subcostal branches emitted from a short footstalk.
Lower radial and third median well separated at their origins.	Lower radial and third median from the same point.
Secondaries with two veins.	Secondaries with three veins.

These characters are all easily seen; but others are indicated which have rather a specific than a generic value, such as the form of the outer margin of the primaries, which in *Doratopteryx* is slightly sinuous (geschwungen), whereas in *Pedoptila* it is regularly arched, the slightly shorter inner margin of these wings in the former genus and the different coloration, the type of *Doratopteryx* having the wings smoky brown, with the basal area golden yellow, whereas *Pedoptila* is grey, with the base bright russet reddish.

One difference which appears in the two figures is due to an injury to the type of *Pedoptila*. In *Doratopteryx* the first subcostal branch forks into two towards the apex; this has, however, clearly been the case with *Pedoptila*, only the apical portion of both primaries in Mr. Swanzy's specimen is broken

away, so that only the commencement of the fork is visible on one side with the help of a lens.

I cannot at all agree with Herr Rogenhofer in his view that these genera should be placed near to *Procris*; the entire structure is, in my opinion, that of the Chalcosiidæ, and, indeed, we have an unnamed genus in the Museum, unfortunately without any indication of locality, which is distinctly intermediate between *Pedoptila* and *Agalope*, being almost of the form of the latter; but not at all widely differing from the former in neuration, excepting that there are several cross-veins (three on one side and four on the other) uniting the costal vein of primaries to the costal margin, and that the subcostal vein has the normal number (five) of branches.

Mr. M'Lachlan, who examined the type of *Himantopterus* and described its structure in the Belgian 'Entomological Annals' for 1877, kindly forwarded to me his very careful sketches; I, however, failed to note in his sketch of the hind wings the discocellular vein of his description:—"Il n'existe pas de réticulation transversale, excepté une seule veinule discoïdale." I regard the presence of this veinlet as most important, since it proves the existence, in however rudimentary a condition they may be, of the subcostal and median veins, neither of which are, however, represented in the published figures or even referred to.

In my figure of *Pedoptila* I see that the engraver has transposed the numbers $\frac{2}{1}$, thus giving the impression that the moth is twice the size of the woodcut. I failed to note this error on the proof of the cut.

VI.—*On the Blue-belted Species of the Butterfly-genus* Prothoë. By Arthur G. Butler, F.L.S., F.Z.S., &c.

The genus *Prothoë* has hitherto been supposed to contain only one blue-belted species, *Prothoë Franck* (subsequently corrected to *Franckii*) of Godart's 'Encyclopédie.'

Prothoë Franckii was described in 1819 from a single male specimen received from Java; the diagnosis at the head of the description runs as follows:—

"*Nym.* alis subcaudatis, supra nigris: anticis fascia obliqua alba azureo marginata: posticis subtus basi fusco inscriptis, apice virescenti pulverulentis."

Hübner, in his 'Sammlung exotischer Schmetterlinge,' vol. ii., gives an admirable figure of the male, and Hewitson,

in the 'Genera of Diurnal Lepidoptera,' a very fair figure of the female.

In the museum collection there are four examples of the Javan species, two males and two females, collected by Dr. Horsfield; a fifth specimen, without locality-label, stands in the Hewitson collection as the female of an allied species, although it is in fact a male.

In 1854 the museum purchased a specimen of a *Prothoë* in a mixed collection of insects from various localities, but bearing no definite indication as to whence it came; it is likely enough to be the missing Malacca form which Mr. Distant quotes on the authority of Wallace. This local form or species stood in the museum for many years as the supposed male of *Prothoë Franckii*; and consequently when, in 1867, and again in 1882, we received specimens of a third species from Borneo and Tenasserim, I for the time believed them to represent an interesting variety of the male approaching the female in coloration; in the Hewitson collection are three examples of the same form, evidently regarded by him as males of *P. Franckii* (though the first in the series is a female).

In a collection received in 1880 from Dr. George Watt and made by him in Manipur, was a male specimen of a fourth species perfectly distinct from the three previously received; this species will be described in full in a paper giving an account of Dr. Watt's collection.

The four species may be separated as follows:—

a. Primaries above with the oblique belt moderately broad (more so in the male than the female), cobalt-blue, intersected by a broad white band; apical area of secondaries purplish brown; prevalent colouring on external area of secondaries below grey .... *P. Franckii.*

b. Oblique belt of primaries shining azure or greenish, with a series of irregular white dashes to represent the central belt; apical area of secondaries purplish black; prevalent colouring on external area of secondaries below pale green.. *P. angelica.*

c. Oblique belt of primaries without white band or spots, excepting upon the costal border; apical area and external border of secondaries chocolate-brown.

c. 1. Oblique belt moderately broad, greenish blue; secondaries elongated, as in *P. Franckii*, with well-marked caudal appendage, apical markings white with bluish borders; prevalent colouring on external area of secondaries pinky greyish .... *P. uniformis.*

c. 2. Oblique belt very broad, covering nearly half the wing, three spots of the same colour at centre of external border, only separated from the belt by a blackish submarginal stripe; secondaries decidedly shorter and less caudate, apical markings blue; prevalent colouring on external area greyish olivaceous, black and green .... *P. regalis.*

Of the above species *P. Franckii*, in spite of its conspicuous white band, is almost the dullest; the male is a little brighter in colouring than the female, and has a slightly narrower white band across the primaries, but does not otherwise differ. It comes only from Java (five examples).

Even more dull in colour is *P. uniformis*, and the absence of the white band makes it appear more sombre than it really is. It differs in many respects from *P. Franckii*, the greater portion of the outer edge of the blue belt being occupied by a long shallow sinus instead of being acutely zigzag; some of the markings on the under surface are also confluent and the discoidal spots are clearer in outline. I can only guess at the probable habitat, as at present we only possess one male.

P. angelica is the brightest of all, the female being slightly less so than the male; the blue belt is sometimes a little wider than in *P. Franckii* and its outer edge is much less zigzag; it has white dashes on the belt in both sexes; the markings below are very similar, but the ground-colour is noticeably different. It occurs in Tenasserim, Borneo, and Sumatra (five examples).

P. regalis is duller in colouring than the preceding, and corresponds with *P. uniformis* in the absence of white on the blue belt; it, however, differs from the three preceding species in the great width of the blue belt, the blue marginal spots on the primaries, the shorter and less caudate secondaries, the cruciform character of the black submarginal markings on under surface of primaries, the filled-in discoidal markings on all the wings, the inner half of external area of secondaries below being greyish olivaceous crossed by oblong black patches with reddish external borders, the shorter green and black submarginal arched spots, and several other characters to be described hereafter. I have only seen one male of this very distinct species, from Manipur.

VII.—*Notes on Mesozoic Cockroaches.* By Samuel H. Scudder*.

I. Pterinoblattina, *a remarkable Type of Palæoblattariæ.*

Among the many fossil cockroaches figured by Westwood thirty years ago was one which Giebel afterwards named *Blatta pluma*, on account of the resemblance of its neuration to the barbs of a feather, where the shaft is on one side. Several species are now known, and on account of this curious arrangement of the veins, the generic name

* From the Proc. Acad. Nat. Sci. Philad. 1885, pp. 105–115.

PTERINOBLATTINA (πτέρινος)

is proposed. The wings were very broad, expanding considerably beyond the base, broadest beyond the middle, and filled with an abundance of branching veins. The mediastinal, scapular, and externomedian veins ran close together, side by side, in a perfectly straight course (the shaft of the feather), from near the middle of the base of the wing toward and nearly to a point on the costal margin a little within the apex of the wing, and the superior mediastinal and inferior externomedian branches, crowded closely together, parted from this apparently common stem at nearly similar angles on either side of it. The complete independence of the mediastinal, scapular, and externomedian veins shows that the genus falls in the Palæoblattariæ. The species are all small.

Pterinoblattina pluma.

Blatta pluma, Gieb. Ins. der Vorw. p. 322. Figured by Westw. Quart. Journ. Geol. Soc. Lond. x. pl. xv. fig. 14†.

The specimen, the original of which I have had the privilege of studying, by the favour of my kind friend, the Rev. P. B. Brodie, is rather imperfect, and a little deceptive from the fact that just that portion of the tip is missing which contains the scapular branches; it is probable, however, from the longitudinal character of the apical externomedian offshoots, that the species more closely resembles *P. chrysea* than *P. intermixta*. All the mediastinal branches are simple, parallel, equidistant, almost straight, closely crowded, and part from the main stem at an angle of about 45°. The externomedian branches, the only others preserved, part at a less angle, gradually become quite horizontal apically, are nearly as close at base as the scapular branches, and as most of them fork and even refork, though with entire irregularity, become excessively crowded towards the margin. The length of the fragment is 9 millim., its breadth 5 millim. Probably the wing was 12 millim. long, and 5·5 millim. broad.

It was found in the Corbula or Pecten beds of the Dorset Purbecks of England.

Pterinoblattina penna, sp. nov.

The single specimen of this species at hand is preserved in much the same manner as the last, but shows a fragment of the internomedian region. The three principal veins approach each other very gradually, so as to give them the appearance of a tapering rod. The mediastinal branches part from the stem at nearly a right angle near the base of the wing, gradu-

ally increasing in obliquity distally until they form an angle of 45° with it; they are slightly curved, the concavity outward, very closely crowded, and about every third one forked near the middle, but with no regularity. The scapular branches are not preserved, but as in *P. pluma*, and for the same reason, they probably resemble *P. chrysea* rather than *P. intermixta.* The externomedian branches are very closely crowded, generally straight, part from the stem at an angle of 45° next the base, and become almost wholly longitudinal at the apex; they fork about as frequently as, and more irregularly than, the mediastinal branches. The internomedian area extends far out on the wing, and its branches (what few can be seen) resemble those of the preceding area, and at its extremity are parallel to them. Length of fragment 13 millim., width 9 millim.; probable length of wing 15 millim., probable width 9 millim.

Described from a specimen from the English Purbecks sent me for examination by Rev. P. B. Brodie.

It is not impossible that the fragment of a larger wing figured by Westwood (Quart. Journ. Geol. Soc. Lond. 1854, pl. xvii. fig. 7), from the Lower Purbecks of Durdlestone Bay, may be a species very close to this.

Pterinoblattina chrysea.

Blattina chrysea, E. Geinitz, Zeitschr. deutsch. geol. Gesellsch. 1880, p. 520, pl. xxxii. fig. 2.

In this case we have a more perfect wing, the tip being almost completely preserved. The mediastinal vein terminates before the middle of the outer half of the costal border, and is furnished with simple, straight, oblique branches, not so numerous as in the other species, to judge by the figure, though they are spoken of by Geinitz as "very numerous and closely crowded." Just before the scapular reaches the tip of the mediastinal, it turns parallel to the costal margin, runs to the upper tip of the wing, and emits branches similar to those of the mediastinal, but of course of equal length. All the externomedian branches run almost longitudinally, are straight, sometimes forked, and appear from the figure to be less crowded than the mediastinal branches, though they are compared by Geinitz to the barbs of a feather. The internomedian runs to just beyond the broadest part of the wing, being thus longer than the mediastinal, and sends less crowded, gently curved, usually forked, rather short branches to the border. The few anal branches curve and strike the inner margin. Length 5 millim., breadth about 2·25 millim.

From the Lias of Dobbertin, Germany. The description is drawn up from the data given by Geinitz.

Pterinoblattina intermixta, sp. nov.

A nearly complete wing of this species has almost the same shape as *P. chrysea*, but the upper part of the apex is more produced. The mediastinal vein terminates before the middle of the outer half of the wing, and the area narrows more gradually than in any of the others; its branches are gently curved, and often forked, but not excessively crowded. Just before reaching the tip of the mediastinal the scapular vein suddenly bends towards the apex, running subparallel to, but away from, the costal margin, terminating at the tip and emitting a crowd of curved and forked branches. The closely crowded externomedian branches part at an angle of 45° with the stem, are straight, and forked only just before the tip, forming a tolerably regular belt of crowded veinlets along the margin. The basal branches, however, are interfered with and affected by the internomedian vein, which is nearly straight, at first running plump against the externomedian branches, curves then downward parallel to these, and terminates a little before the mediastinal; it is furnished abundantly with branches curving like its extremity and branching next the border like the externomedian branches; but where it abuts against these latter they simulate the appearance of the internomedian branches so as to appear as if a part of the internomedian area, and thus give the latter the appearance of extending out beyond the broadest part of the wing. The anal appears to be insignificant, reaching less than a third the distance from the base, and resembling a narrower and smaller internomedian area. Length of fragment 10·5 millim., probable length of wing 12 millim.

Received from Rev. P. B. Brodie, as coming from the Upper Lias of Alderton, Gloucestershire, England.

Pterinoblattina hospes.

Ricania hospes, Germ. Acta Acad. Leop. Carol. xix. pp. 220, 221, pl. xxiii. fig. 18.

Germar took this for one of the Fulgorina, in the neighbourhood of *Ricania* and *Pœciloptera*. It is pretty plain, however, that it belongs here, though the figure given by Germar is not sufficiently clear to enable one to formulate any characteristics. Assmann thought it a Neuropteron, falling in the neighbourhood of *Drepanopteryx*.

It comes from the Oolite of Solenhofen.

Pterinoblattina gigas.

Ricania gigas, Weyenb. Arch. Mus. Teyl. ii. pp. 270, 271, pl. xxxv. fig. 23.

Following Germar, Weyenbergh placed this enormous species in *Ricania*; but it as evidently falls here and bears a close general resemblance, excepting in size, to *P. penna* of the Purbecks. *Ricania fulgens*, Gieb. (Brodie, pl. iv. fig. 12), from the Vale of Wardour, has nothing to do with *Pterinoblattina*.

This gigantic form also comes from the Oolite of Solenhofen.

II. *Triassic Blattariæ from Colorado.*

In a recent paper I described some of the Triassic Palæoblattariæ, which I mentioned as interesting on account of their special relation to the Blattariæ of the same formation. Brief diagnoses of these latter forms will therefore have some interest, and I mention them in the order of their relation to the Palæoblattariæ.

NEORTHROBLATTINA (νέος, ὄρθρος), gen. nov.

In this genus the wings are about two and a half times longer than broad, with fairly well-rounded apices, the mediastinal and scapular veins amalgamated into a single vein, which extends nearly to the tip, and in the middle of the wing occupies nearly one half its width. The internomedian vein is of varying importance, and in the large anal area the veinlets terminate on the margin; the anal furrow is strongly arcuate and deeply impressed.

Neorthroblattina albolineata, sp. nov.

The single wing has lost the tip, but all the essential features are preserved excepting the form of the tip. The wing is very dark-coloured, and the veins appear as very pale lines upon it. The costal margin is gently and equably arched, while the inner margin is perfectly straight. The externomedian vein is little developed, first forking, and then not widely, in the middle of the wing, its fuller development being prevented by the ample and unrestricted development of the internomedian vein, which runs in a full rounded course nearly to the tip of the wing. The anal area is interesting because the veins of the upper half run close to, but do not impinge upon, the anal furrow, curving downward just before reaching it, and either running into the next vein below and terminating there, or continuing parallel to the furrow and terminating on the inner border. Length of fragment 7

millim.; probable length of wing 9 millim.; breadth of wing 3·5 millim.

Triassic beds near Fairplay, Colorado.

Neorthroblattina Lakesii, sp. nov.

Several specimens of this species were found. The costal margin is arched, as in the last species, and the inner margin has an almost equal opposite curvature. The externomedian vein has a very sinuous course, and forks before the middle of the wing with abundant neuration, occupying on the margin the entire tip of the wing and almost the outer half of the lower margin, while the internomedian is reduced to an arching vein, extending but little beyond the anal furrow, and with only two or three branches; the anal veins are all parallel to the anal furrow and simple. Length of wing 9 millim.; breadth 3·5 millim.

Triassic beds near Fairplay, Colorado.

This species is named after Prof. Arthur Lakes, of the School of Mines in Golden, Colorado, who first made known these beds, this species being one of the first discovered by him.

Neorthroblattina rotundata, sp. nov.

The costal margin in this species is very strongly arched, while the inner margin is straight, giving a very different aspect to the wing. It closely resembles the preceding species in the mediastino-scapular and anal areas, and also in the peculiarities of the externomedian vein, excepting that the latter does not encroach to so large a degree upon the internomedian, the terminal offshoot of which creeps along the border so as to limit the marginal extent of the externomedian area almost as much below as above, although the branching of the externomedian vein is scarcely lessened. Length of wing 8·5 millim.; breadth 3·3 millim.

Triassic beds near Fairplay, Colorado.

Neorthroblattina attenuata, sp. nov.

This species departs from the typical forms in its slenderness and pointed apex, but it agrees so fairly in general structure that it would best be placed here. The costal margin is not regularly arched, being flattened mesially, while the whole wing tapers beyond the basal third; the inner margin is also arcuate, and the tip bluntly pointed. The mediastino-scapular vein terminates considerably before the apex, and the oppositely arcuate internomedian reaches

almost as far out, the branches of both nearly always simple. The anal veins are only slightly irregular. Length of wing 15 millim.; breadth 4 millim.

Triassic beds near Fairplay, Colorado.

SCUTINOBLATTINA (σκύτινος), gen. nov.

In this genus, composed of small species, the front wings are decidedly more coriaceous than the hind wings, so that the neuration is often more or less obscured by it. The wing itself is convex, as in the modern *Phoraspis*, and subtriangular in form, its greatest width being near the base, while the tip is bluntly pointed. The mediastinal and scapular veins are again blended into one, which, instead of having a sinuous course, is nearly or quite straight, and terminates below the apex of the wing, while the externomedian vein follows closely parallel to it, and the oblique veins of this and the internomedian veins follow each other so as to make it difficult to tell where the line of demarcation may lie. The anal veins sometimes fall on the margin and sometimes on the anal furrow.

Scutinoblattina Brongniarti, sp. nov.

In this interesting species the wings are very strongly convex at the base and the whole surface is flecked with dark spots. The branches part from the main veins at a similar angle on either side of the middle of the wing. The anal area extends nearly to the middle of the wing, where it is marked by a considerable emargination, and its veins are frequent, oblique, mostly simple, and terminate on the margin. Length of wing 7 millim.; breadth 3 millim.

Triassic beds near Fairplay, Colorado.

Named after Mr. Charles Brongniart, of Paris, well known for his remarkable discoveries among the older fossil insects.

Scutinoblattina intermedia, sp. nov.

This species resembles the last, but is not marked by any dots, and the anal area, while shorter, shows no emargination of the border at its extremity; the anal veins are very close, parallel to the inner margin, and terminate not on the margin, but on the anal furrow. It further differs in that the externomedian branches are considerably more longitudinal than those terminating on the costal margin. Length of wing 7 millim.; breadth 2·75 millim.

Triassic beds near Fairplay, Colorado.

Scutinoblattina recta, sp. nov.

This species, the smallest and most abundant of all in the Triassic rocks, is rather slenderer than the others, and has the surface finely reticulated. The mediastino-scapular and externomedian veins run side by side in perfectly straight lines from the middle of the base to the middle of the tip, the branches, very few in number, parting similarly on the two sides. The costal is more arched than the inner margin, and where they can be made out the one or two anal veins seem to run to the margin; but all the veins on the wing are exceedingly obscure. Length of wing 6·3 millim.; breadth 2·4 millim.

Triassic beds near Fairplay, Colorado.

III. *On the Genera hitherto proposed for Mesozoic Blattariæ.*

Brodie, in 1845, published figures of a considerable number of Mesozoic cockroaches, but named only one, which he referred to the genus *Blatta*. In 1852 Heer figured and named another under the equally broad generic name *Blattina*. Westwood, in publishing in 1854 a considerable addition to our knowledge of the cockroaches of the English Mesozoic rocks, separated four somewhat peculiar forms under the generic term *Blattidium*; the rest were unnamed. Giebel, two years later, named a considerable proportion of Brodie's and Westwood's species; while placing a considerable number under *Blatta* and *Blattina*, he divided the rest under three new genera—*Rithma*, *Elisama*, and *Nethania*—the last including the only one of Westwood's species of *Blattidium* which was noticed. On the other hand, Heer, in 1864, divided all the Mesozoic species between *Blattina* and *Blattidium*, placing in the latter all of Westwood's species, together with all those referred to new genera by Giebel. Finally, a few years ago, E. Geinitz proposed for a Triassic species described by him, and one previously published by Heer, the new generic term *Mesoblattina*.

There is no question that the forms described by Westwood, after eliminating the one separated by Giebel under the name of *Nethania*, form a very distinct group; but none of the species since added to it belong here, so that

BLATTIDIUM

should stand much as first limited (though not described) by Westwood. Probably, however, it should be still further restricted by the elimination of *B. achelous*, Westwood. The

wings are exceedingly long and slender, particularly in *B. symyrus*, Westw. (which may be taken as the type), with nearly or quite parallel sides. The mediastinal vein terminates not far from the middle of the wing, and sends out a multitude of crowded offshoots to the margin. The scapular vein unites in the basal third of the wing with the externomedian, and throws off rather distant oblique veins, first to the mediastinal and afterwards to the border. The externomedian and internomedian veins have together several more or less forked very longitudinal branches, all of which appear to terminate on the apical margin, while the main anal vein, longitudinally oblique, extends nearly as far as the mediastinal, and the outer half of the inner margin of the wing seems to have no veins falling upon it; the veins of the anal area run obliquely from the margin upward and outward to the main anal vein.

As to the genera of Giebel, six species are placed by him in *Rithma*, two in *Elisama*, and one in *Nethania*. The species of *Nethania* is rather too uncertainly figured to determine by the illustration alone where it belongs. The two species of

Elisama

figured by Brodie certainly belong together, and seem to constitute a natural genus. By the kindness of the Rev. Mr. Brodie I have seen the original of his pl. v. fig. 1 (*Elisama Kneri* of Giebel) and another specimen which seems to belong to *E. minor*, so that I can more fully characterize this genus. The mediastinal and scapular veins appear here to constitute one vein, and to occupy almost the entire upper half of the wing. The externomedian and internomedian veins fill the lower half between them with parallel veins, which at their origin curve at once strongly downward, and then run longitudinally to the apical margin, leaving only the meagrest possible space to the anal area, which is indeed broken off from the two specimens I have seen, and does not appear in the figures published by Brodie. In addition, in both the species there is an abundant but imperfect cross-venation at the base of the externomedian and internomedian areas, and on the latter a large discoloured spot, which may of course be confined to these two species only.

Rithma

contains more incongruous material. I have myself recognized in the English species I have examined autoptically only one of the species referred to it, named *R. Murchisoni*

by Giebel, and this is certainly to be referred to *Mesoblattina*, Geinitz. *R. ramificata* is quite too imperfect to be considered until better specimens occur. It is probable that *R. antiqua* should be separated from the others, and the same may be true of *R. Westwoodi*. This leaves two species, *R. purbeccensis* and *R. Morrisi*, which agree well together, and represent a group which seems to have flourished in Mesozoic times, as I have seen a number of species from the English Lias belonging to it; and *Blattina formosa*, Heer, from Schambelen, and *Blattina liasina*, Gieb., figured by Brodie, also belong here. These wings are rounded wedge-shaped, with the amalgamated mediastinal and scapular area so large as to occupy about half of the wing, the vein running in a slightly sinuous course to, or even below, the tip. The anal area is generally pretty large, convex, and filled with parallel veins, which terminate on the margin. The space between is divided about equally between the externomedian and internomedian veins, which generally take a somewhat sinuous course, and fork with tolerable abundance, filling the space with graceful lines, spreading like (sinuous) rays of a fan. The genus is closely related to *Neorthroblattina* of the American Trias, but differs from it in the much greater area covered by the amalgamated mediastinal and scapular veins.

The following described species may be referred to it:—

Rithma purbeccensis.

Rithma purbeccensis, Gieb. Faun. d. Vorw. iii. p. 319. Figured by Westw. Quart. Journ. Geol. Soc. Lond. x. pl. xviii. fig. 32.

Lower Purbecks, Durdlestone Bay, England.

Rithma Morrisi.

Rithma Morrisi, Gieb. Faun. d. Vorw. iii. p. 319. Figured by Westw. Quart. Journ. Geol. Soc. Lond. x. pl. xviii. fig. 34.

Lower Purbecks, Durdlestone Bay, England.

Rithma formosa.

Blattina formosa, Heer, Lias Ins. Aarg. p. 15, pl. H. figs. 41, 42; id. Urw. Schweiz. pl. vii. figs. 1, 1 *b*

Lias, Schambelen, Switzerland.

Rithma liasina.

Blattina liasina, Gieb. Faun. d. Vorw. iii. p. 317. Figured by Brodie, Foss. Ins. Engl. pl. viii. fig. 12.

Lower Lias of Wainlode, Strensham, England.

MESOBLATTINA,

proposed by E. Geinitz, as stated, for two Liassic species of continental Europe, is a most prolific type, a considerable number of English Mesozoic forms falling here, and among others, as remarked above, those figured by Westwood and described by Giebel under the name of *Rithma Murchisoni* and *R. antiqua*. The former of these, as well as a considerable number of new species, have been sent to me by Mr. Brodie. In this genus the basal sweep of the externomedian and internomedian veins is very noticeable, following as they do the curve of the anal furrow before branching to fill the lower half of the wing. In this respect they remind one strongly of *Elisama*; but the wings are much slenderer than there, and, what is of more importance, the anal area is of the normal size, while next the humeral angle is seen a flat unveined field, so frequent in modern cockroaches. To this belong, among others, the following species:—

Mesoblattina protypa.

Mesoblattina protypa, Gein. Zeitschr. deutsch. geol. Gesellsch. 1880, pp. 519, 520, pl. xxii. fig. 1.

Lias of Dobbertin, Germany.

Mesoblattina angustata.

Mesoblattina angustata, Gein. Zeitschr. deutsch. geol. Gesellsch. 1880, pp. 519, 520.
Blattina angustata, Heer, Viert. naturf. Gesell. Zürich, ix. pp. 288–300, pl. fig. 6.

Lias of Schambelen, Switzerland.

Mesoblattina dobbertinensis, Gein.

Mesoblattina dobbertinensis, Gein. Zeitschr. deutsch. Geol. Gesellsch. 1884, p. 570, pl. xiii. fig. 1.

Lias of Dobbertin, Germany.

Mesoblattina Murchisoni.

Rithma Murchisoni, Gieb. Ins. d. Vorw. p. 319. Figured by Westw. Quart. Journ. Geol. Soc. Lond. x. pl. xviii. fig. 43.

Lower Purbecks of Durdlestone Bay, England.

Mesoblattina antiqua.

Rithma antiqua, Gieb. Ins. d. Vorw. p. 319. Figured by Westw. Quart. Journ. Geol. Soc. Lond. x. pl. xvii. fig. 10.

Lower Purbecks of Durdlestone Bay, England.

Mesoblattina elongata.

Blatta elongata, Gieb. Ins. d. Vorw. p. 322. Figured by Westw. Quart. Journ. Geol. Soc. Lond. x. pl. xv. fig. 23.

Middle Purbecks of Durdlestone Bay, England.

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The Birds of Lancashire. By F. S. Mitchell.
Post 8vo. London: Van Voorst, 1885.

We hail the appearance of Mr. F. S. Mitchell's neat and exhaustive little handbook on 'The Birds of Lancashire' with great pleasure. Previous to the issue of this work we possessed no standard information of any kind in a collective form respecting the avifauna of the vast district lying between the Bristol Channel and the Solway Firth. This hiatus is keenly felt by those naturalists who have occasion to work out the distribution of birds in the British Islands. The west of England and the whole of Wales have been much neglected by the "local naturalists;" but we hope that the careful observations made by Mr. Mitchell will prove contagious, and that his useful handbook will be followed by similar works dealing with the other western counties, until the birds are as well known and their distribution as accurately determined as in the eastern counties. Without aspiring to the pretensions of such works as Stevenson's 'Birds of Norfolk' or Gray's 'Birds of the West of Scotland,' Mr. Mitchell's handbook supplies us with much information which we fail to find in those more elaborate works. We allude to the careful way in which the time of arrival and the date at which each species lays its eggs is given—information which will be of the highest service to many a young naturalist in the northern counties. Nor will the numerous local names of birds be less welcome to many readers. Much valuable information is given respecting the occurrence of wild fowl on the coasts of a county eminently suited to the requirements of such birds, which the shore-shooter will do well to study; and many "straight tips" and quiet hints are given respecting the modes by which they are captured; whilst a considerable amount of interesting archæological information is incorporated. The charming woodcuts by Whymper of the "decoy pipes," showing the method by which the wary ducks are lured to their doom, are exceptionally realistic. In addition to numerous woodcuts the work is embellished by two beautiful coloured plates by Keulemans, one of the Black-throated Wheatear (a bird which has hitherto only been met with in the United Kingdom in Lancashire), and the other of the Wall-Creeper. Several occurrences of rare birds in the British Islands are here recorded apparently for the first time; and not a few interesting particulars are given concerning the habits of many species. We must doubt, however, the correctness of Mr. Mitchell's assertion that the Starling is only single-brooded—in the adjoining county of York it certainly rears two, if not three, broods in the season. Lancashire compares most favourably with other counties with regard to its avifauna, which we are told numbers 256 species. No less than 116 of these are given as breeding within the limits of the county,

whilst 65 are winter visitors and 75 occasional visitors. The range of each is carefully traced through the county, and the time of arrival, nidification, number of broods, number of eggs, comparative abundance, together with numerous notes of local interest and peculiarities of habit, are given.

In short, Mr. Mitchell has performed his task well, and has obviously been at much pains to render his information as complete and reliable as possible. The work will be welcome and useful to all who take an interest in British birds, and must prove indispensable to the many north-country artisan-naturalists whose leisure time from toil in noisy mill or factory is spent in studying natural history in the suburbs of their crowded towns. We hope that provincial naturalists will not rest until every county not yet favoured with a handbook to its bird-life can boast of one planned with as much care and carried out with as much completeness as the useful and interesting little volume before us. C. D.

Memoirs of the Geological Survey of India. Palæontologia Indica, being Figures and Descriptions of the Organic Remains procured during the Progress of the Geological Survey of India. Published by order of His Excellency the Governor-General of India in Council. Series x. *Indian Tertiary and Post-Tertiary Vertebrata.*—Vol. III. Part 1. *Additional Siwalik Perissodactyla and Proboscidia*, with 5 plates and 6 woodcuts. Part 2. *Siwalik and Narbada Bunodont Suina*, with 7 plates and 1 woodcut. Part 3. *Rodents and new Ruminants from the Siwaliks, and Synopsis of Mammalia*, with 1 plate and 8 woodcuts. Part 4. *Siwalik Birds*, with 2 plates. Part 5. *Mastodon Teeth from Perim Island*, with 2 plates. By R. Lydekker, B.A., F.G.S., F.Z.S. 4to. Calcutta: Geological Survey Office. London: Trübner & Co. 1884.

The Memoirs included in Mr. Lydekker's third volume of Indian Tertiary Vertebrata are varied in matter and vary in importance. We may say of the volume as a whole, that it makes an important, valuable, and welcome contribution to the knowledge of the subjects of which it treats; and every anatomist will need to examine in detail the materials described and discussed in the successively issued parts of the work.

Part 1 opens with an account of *Aceratherium Blanfordi*, founded on materials collected by Mr. W. T. Blanford in the Lower Siwaliks of the extreme west of India.

Upper molar teeth of two races of this rhinoceros are described, which differ in size. Its affinities are with the *Rhinoceros palæindicus*, which, however, has the external surface of the molar teeth flatter. The bases of the two colles are in contact in *R. palæindicus*, and that species wants the tubercle at the entrance to the median valley. The distinction of *A. Blanfordi* from *Rhinoceros sivalensis*

is found in that species having the second costa of the molar teeth more prominent, in the anterior collis having no vertical groove on its posterior side, in the ante-crotchet of *A. Blanfordi* being absent, while the crotchet is relatively larger. The molar teeth of *Aceratherium perimense* are distinguished from those of *A. Blanfordi* by greater development of the buttress and costa, while the ante-crotchet is less developed, and the posterior valley forms a deep pit instead of a slit. Figures are given of the mandible, showing its general form, and indicating that the symphysis approximated to the characters of the Javan rhinoceros.

The lower molars have a faint trace of an external cingulum. After comparing this Indian fossil with other species of rhinoceros, the author concludes that there is a strong presumption that it is an *Aceratherium*, though it is difficult at present to establish distinction from its American allies. The two races are distinguished as *majus* and *minus*. Among European types it finds its nearest ally in *A. incisivum*; and the *Rhinoceros deccanensis* is thought to have been a descendant from the same stock as *Aceratherium Blanfordi*.

Hipparion antilopinum has a cranium referred to it from the Siwaliks of Perim Island, in which the teeth exhibit the complete isolation of the anterior pillar characteristic of *Hipparion*, though the pillar is less elongated than in the teeth referred to *H. Theobaldi*. Still, the skull is only determined provisionally, and is compared with *H. gracile*, with the conclusion that the form of the posterior maxillary cavity establishes a specific distinction. Other teeth from Perim Island are described, and if they prove to belong to a new species it may be named *H. Feddeni*.

The remainder of the memoir is devoted to Mastodons. Three tretalophodont species and two trilophodont species have been already described from the Siwaliks, and the author now indicates trilophodont types. Concerning the genealogy of the Elephants, it is observed that the presence of simple tetraconodont premolars in some Mastodons suggests their descent from some ungulate with teeth of this type, in which premolars were as fully developed as molars; and that it is merely necessary to assume the addition of an extra pair of columns in each of the true molars of the Bunodont Artiodactyla to produce a dentition analogous to that of the simple-toothed Mastodons. A variety of *Mastodon angustidens* named *M. palæindicus* is described from teeth. It has a tendency to a rather more complex structure of the molars than is usual in the European type, and there is a greater curvature of the borders of the crown in the third molar of the lower jaw, both these characters approximating towards *M. pandionis*, with which it is associated in the extreme western border of India. Further descriptions are given of teeth of *Mastodon pandionis*, which is also closely allied to *Mastodon angustidens*, though the structure of the molars is more complex and the cement of the teeth is developed. It appears to have survived to a later epoch than *M. angustidens*, being found in the Upper Siwaliks.

The third type of this group is the new species *Trilophodon Falconeri.* The tooth differs from those of *M. pandionis* in its smooth enamel, low vertical ridges, wide transverse valley, and trefoil-shaped dentine islets.

Part 2 opens with a statement of the author's conviction that the Indian species of *Dinotherium* must be maintained, and are not to be identified with the European type.

Dr. Falconer's divisions of the genus *Hippopotamus*, named *Hexaprotodon* and *Tetraprotodon*, are here united, and Leidy's genus *Chœropsis* is included with them in the genus *Hippopotamus*. Some account is given of crania of *Hippopotamus sivalensis*, in which the molar teeth vary in proportions; and the author finds that a large series of vertebræ and limb-bones show distinctions from *Hippopotamus amphibius*. The spinous process of the axis is higher, the odontoid process blunter; the scapula has its long diameter shorter; the femur apparently includes two types; the astragalus is longer than in *H. amphibius* and approximates to the pigs.

A small hippopotamus from Burma, named by Falconer and Cautley *Hexaprotodon iravaticus*, is distinguished from *H. sivalensis* by the shorter symphysis and the greatly diminished interval between the canines, in which characters it makes a nearer approach to the pigs than any other hippopotamus. The species *H. namadicus* was referred to by Falconer as larger than *H. amphibius* or *H. sivalensis*. It has only been obtained from the Narbadas, and the author observes that the crania referred by Falconer to *H. palæindicus* might with equal reason be referred to *H. namadicus*, and describes a mandible. *H. palæindicus* presents a singular type of mandible, the jaw being that of a *Hexaprotodon* in process of conversion into a *Tetraprotodon*, the middle incisors being forced inwards and greatly reduced in size by the development of the first and third incisors. The *H. iravaticus* is the most generalized Indian species, and steps of successive modification are exhibited by the species *H. sivalensis*, *H. namadicus*, and *H. palæindicus*, at least as shown in the increased shortening of the symphysis of the mandible. *H. amphibius* in length of symphysis rather exceeds the Narbada hippopotamus, its inner incisors are large and the outer incisors small; but in *H. liberiensis* the small outer incisor has disappeared.

The representatives of swine among the Siwalik rocks are referred to the genera *Sus*, *Hippohyus*, *Sanitherium*, and *Hyotherium*. An interesting summary of modifications of the genus *Sus* precedes the description of Indian species. *Sus giganteus* of Falconer and Cautley is described from specimens of crania, dentition, and mandible, so as to show its differences from *S. scrofa*, *S. cristatus*, *S. barbatus*. The third and fourth premolars of this species are wider and stouter than the corresponding teeth of most existing pigs; but the structure is similar to that of the premolars of *Tetraconodon*. *Sus titan* is a new species founded on mandible, cranium, teeth, and limb-bones, and is regarded as distinct from *S. giganteus*. The first and second molars are of narrower and more elongated type than in that species; but whether it is distinct from the European types may admit of

some doubt, and it is stated that *S. titan* in the structure of its lower premolars is intermediate between the mandible referred to *S. giganteus* and the fossil European pigs. Another species is named *Sus Falconeri*, and although the name is new it is adapted to some well-known materials. Its cranium approximates to that of the living *S. barbatus* of Borneo, though the living species has the palate more produced behind the third molar tooth; and this fossil is well distinguished from most of the other fossil species by the structure of its molars, which are of complex character. In this structure it makes an approximation to *Phacochœrus*, especially in its last lower molars, which might be converted into those of *Phacochœrus* if the main columns were isolated and reduced to the size of the accessory columns. In another direction the teeth of this species approximate to the still more complex molars of *Hippohyus*. *Sus hysudricus* is a fourth species, figured by Falconer, known from ample materials, which indicate that it is distinct from living pigs in having larger and stouter premolars, which somewhat approximate to those of the African river-hogs, and in having the molars of the male wider with lower crowns. The last upper molars have a conspicuously developed cingulum. A fifth species is *Sus punjabiensis*, known from a mandible. It was a diminutive pig, no larger than the existing pigmy hog of Nepaul, of which it is supposed to be the ancestor. It was about as large as a hare.

Hippohyus sivalensis is described from the cranium and mandible, which make some approximation to *Hyotherium*, though the structure of the molars is much simpler. The true molars somewhat resemble those of *Hippopotamus*, but have the longitudinal and transverse valleys equally developed. The molars may also be compared with those of *Hemimeryx* or *Hyopotamus*.

Sanitherium Schlagintweiti of Von Meyer is identified with the *Sus pusillus* of Falconer. This genus has a well-marked cingulum which distinguishes it from *Hippohyus*, and in several respects it makes an approximation to *Sus*.

Hyotherium is another genus of Von Meyer's hitherto somewhat loosely identified, which the author recognizes in India. The species *H. scindiensis* is known from a few molar teeth. In *Hyotherium* European specimens show that the canines and lower incisors are but little specialized.

Tetraconodon magnus is a Siwalik type only known from molars and mandible.

Listriodon, which occurs in the Middle Miocene of Europe, is represented by two species in the Siwaliks. It was referred to the genus *Tapirus* by Falconer, and classed with the Bunodont Suina by Lartet. The species *L. pentapotamiæ* is closely allied to the European form; but the second species, *L. Theobaldi*, is smaller and distinguished by having the transverse valley wider and more open, and by wanting oblique ridges running from the anterior and posterior cingula to the summits of the main ridges. The memoir concludes with a list of writings upon the fossils described.

In the third part are descriptions of a few rodents from the

Siwalik beds. *Rhizomys sivalensis* is known from mandibles and a calcaneum, and appears to be distinguished from living species by the relative size and breadth of the molar teeth. The porcupines are represented by a mandible named *Hystrix sivalensis.* Comparisons are made to distinguish it from *H. cristata* and *H. hirsutirostris*, as well as to show its relations with other fossil species. A young cranium is also figured which probably belongs to the same species. Then follow supplementary notes on ruminants. First the *Cervus latidens* of a previous volume is redescribed as *Oreas? latidens*, with the conclusion that the dentition indicates a large antelope nearly equal to the eland, having marked affinity with *Oreas* and less conspicuous affinity with *Tragoceros* and *Palæoryx.* An upper molar is similarly referred with doubt to the genus *Palæoryx.* Other remains are considered to indicate the genus *Boselaphus. Tragulus sivalensis* is a Siwalik type known from its teeth, and the author finds no difference but size to separate the fossil from existing species, though such slight variation as exists makes some approach to *Moschus. Moschus* is a genus indicated with doubt on the evidence of a premolar, and it is remarked that it is impossible to distinguish this tooth from that of the musk-deer except by its smaller size.

The genus *Cervus*, enlarged to include the various subgenera, yields two new species. *Cervus simplicidens* closely approaches in tooth-characters to *Cervus axis*, having the necks of the crowns of the true molars on different levels; but in the living species the third upper premolar is relatively shorter, the outer part of the fourth premolar rather less symmetrical, and the true molars relatively wider. *Cervus triplidens* is nearly allied to the *C. Davidianus.* They have strongly marked costæ on their outer surfaces, and the crowns are higher than those of *Cervus simplicidens.* A third species, *Cervus sivalensis*, is represented by teeth resembling those of *C. Duvaucelli*, but having more rugose enamel, a distinct cingulum, and a smaller accessory column in the molar teeth.

Then succeeds a useful synopsis of the Siwalik and Narbada Mammalia, with references to the original descriptions and to the previous parts of the present work. Advantage is taken of this recapitulation to vary the nomenclature of some of the types.

Part 4 is devoted to the Siwalik birds, some of which have already been described by Mr. William Davies. Among these is the *Pelecanus Cautleyi*, founded on the distal extremity of a left ulna. Although the comparisons have shown it to be distinct from such species as were available for comparison, the author regards the name as provisional, since existing species remain with which no comparison can be made.

A second species is the *Pelecanus sivalensis*, also founded on the distal extremity of an ulna, and for similar reasons the name is regarded as provisional. *Phalacrocorax* is known from a metatarsus, and is almost undistinguishable from *P. carbo* of New Zealand. *Leptoptilus Falconeri* is founded on various remains, which also appear to the author to make the name provisional. An indeter-

minate cervical vertebra is regarded as indicating a Siwalik stork or allied form. The genus *Mergus* is quoted with doubt on the evidence of a cervical vertebra. *Struthio asiaticus* was an ostrich closely allied to the existing species, and the author doubts whether the slight differences in their cervical vertebræ can be of more than individual or varietal value; so that this species is regarded as provisional.

The *Dromæus sivalensis* has since been withdrawn by the author on the ground that the bones must be referred to an Artiodactylate mammal.

Part 5 is devoted to Mastodon teeth from Perim Island. They comprise the first and last upper true molars of *Mastodon pandionis*, and the second right upper true molar, upper milk-molars, and penultimate lower molar of *Mastodon perimensis*; and having described these teeth in detail, the author regards it as evident that the tetralophodont *M. perimensis* is a more specialized form than the trilophodont *M. pandionis*. In order to convert the teeth of the latter into the former type it is necessary that the anterior accessory columns should be less developed, so that the valleys would be more open. A fourth ridge should be developed in the intermediate molars, and a fifth ridge and double talon in the last molar. Both species have cement in the valleys. It is considered as likely that *Mastodon sivalensis* is a descendant from the stock of *Mastodon pandionis*, and it is thought probable that *Mastodon pandionis* and *Mastodon pentelici* are both branches from the older stock of *Mastodon angustidens*.

In this volume a considerable mass of material is made known and illustrated by figures, which for the most part are excellent; and it is a great gain to palæontology for naturalists to be in possession of the author's descriptions. Admirable in many ways, the work suffers from the disjointed manner in which the growth of material has caused the parts to be issued; and some of the descriptions rather convey the impression of unnecessary haste in publishing what might perhaps have been perfected by fuller consideration. There is an appearance of desiring to leave nothing for those who may come hereafter, and yet at the same time to leave open a way for retiring from positions which future research may make untenable. Many of the species instituted by the author seem to us to be founded on characters which would justify us in extending to them the term provisional, which so often characterizes species founded by others. Space might sometimes have been gained which could with advantage have been taken for more extended description. Not but what the descriptions are excellent in their way, only they could in many cases have been fuller with advantage. The author's strong interest is rather with what may be termed genetic comparisons. He has done much to unravel the affinities of species by comparing them with existing and fossil allies; and the speculations on descent of species are usually justified by the nature of the materials and the interest of the problems involved. But suggestive as this pursuit of evolution undoubtedly

is, its value is always in proportion to the degree to which evidence has been previously elaborated by laborious descriptions and comparative figures. The author's mental attitude rather disposes him to write for those who have already written on similar subjects, than for the many who might become students. But even in this he has impressed his own individuality on his work in his own way, and we take that work with much gratitude for the labour, ability, and research which it manifests.

Memoirs of the Geological Survey of India. Palæontologia Indica, being Figures and Descriptions of the Organic Remains procured during the progress of the Geological Survey of India. Published by order of His Excellency the Governor-General of India in Council. Series iv. Vol. I. Part 4. *The Labyrinthodont from the Bijori Group.* By R. Lydekker, B.A., F.G.S., F.Z.S. With 4 plates. Calcutta: Geological Survey Office. London: Trübner & Co. 1885.

The Labyrinthodont which gives a title to this memoir is a new generic type named by the author *Gondwanosaurus bijoriensis.* The name is taken from the geological series, Gondwana system, in which it occurs, and the Bijori group, an upper subdivision of the same series in the Satpura district. The preservation is not all that could be desired, the bones having disappeared from the exposed portions of the specimen. The skull is about the size of that of the well-known *Loxomma Allmanni*, and is shown to be labyrinthodont by the structure of the teeth, a parietal foramen, the presence of epiotic cornua, and the structure of the thoracic shield. Only in the region of the epiotic bones is there a trace of external surface, and there the ornament is closely pitted. The exoccipital region appears to show no trace of the characteristic amphibian exoccipital condyles, a character not without importance in determining the classificatory position of this animal and its allies. The author relies mainly upon the figures to convey a conception of the form, proportions, and structure of the skull, and the relations of its several elements. The outline was triangular, with a rounded muzzle, the length to the breadth being as two to three. The orbits are oval, separated by the diameter of an orbit, and are in the posterior half of the cranium. The parietal foramen is just behind the eyes. An oval plate, which has the aspect of a perforation in the cranial bone, occurs on each side of the foramen. The author regards this as a bony pedicle; but having only the figure to judge from, it appears to us to be an indication of minute temporal fossa, and if so is not entirely without interest as bearing upon the affinities of the group. In the pre-orbital region there is on one side a slight depression, thought to indicate a small lyra. The nares appear to have been near the extremity of the snout. On the palatal aspect there is a similar absence of bony elements; but a

large median element is determined as parasphenoid, on each side of which are bones that appear to be pterygoids. The vomer and palatine are regarded as forming the arrow-head-shaped anterior exposed part of the palate. The mandible is long, straight, and diminishes in depth anteriorly from the condyle. An oval mandibular foramen is described on the middle of the under surface of the jaw. The teeth are imperfect. One or two palato-vomerine teeth remain, and the maxilla and dentary part of the mandible each carry a row of small, close-set, sharp, subcylindrical teeth, which extend back to the orbits. The dentine is simply plicated. Some larger teeth appear to have been placed behind the palatal teeth. The vertebral column is only known from an imperfect cast. The notochord is represented by a large cylinder, somewhat constricted in the middle of each centrum; the intervertebral foramina appear from the figure to have been exceptionally long. The author finds that each vertebra consisted of a bony neural arch, from which a bony plate descended on each side and joined the median ventral portion, and he sees in this structure an analogue of the vertebræ of *Archegosaurus* and *Euchirosaurus*. Each centrum is supposed to support parts of two neural arches. There are impressions of fifteen ribs, which have the usual expanded extremities and double head. The thoracic shield is well preserved, though the central plate is imperfect posteriorly. It is ornamented with radiating sculpture, most developed in front. It has the usual long rhomboidal form. The lateral plates overlap the anterior part of the median plate and terminate posteriorly in a sharp process, beyond which another small shield is found. The dermal scutes appear to have had the form of oats, and were arranged in oblique rows, forming a chevron pattern, with the angle forward, along the length of the specimen. The notochordal character of the vertebral column, with minor ossifications in the centrum, and the simply plicate dentine distinguish this type from all the large labyrinthodonts except *Archegosaurus*; and it differs from that genus in the breadth of the interorbital space, development of the epiotic cornua, in wanting a post-articular process of the mandible, which, on the other hand, has an internal articular buttress; and it further differs in having the rami of the mandible anchylosed, in having large palato-vomerine teeth, with a few mandibular tusks forming an inner series near the symphysis, and in having the summits of the neural spines expanded from front to back and transversely. The author is disposed to refer the genus to the Archegosauridæ, and it is supposed to be a more specialized type than *Archegosaurus*, and of aquatic habit; its geological age is probably Permian.

The memoir concludes with a list of writings on Labyrinthodonts published since 1874. It is an excellent monograph, elaborated in the author's best manner.

MISCELLANEOUS.

A long-tongued Pteropine Bat from West Africa. By Dr. H. A. Pagenstecher.

Megaloglossus Wœrmanni, nov. gen. et spec.

Long-tongued fruit-eating Bats have not hitherto been found further west than the Himalayas. Our Museum (Hamburg) has just received one through M. Soyaux, from Lsibange-Fann in Gaboon. This great change in our zoogeographical experience justifies a preliminary communication.

Our animal belongs to Dobson's second group of the Macroglossi:—"Second finger with a distinct claw; intermaxillary bones united in front." It has the full dentition with $\frac{2}{2}+\frac{1}{1}+\frac{3+2}{3+3}$ on each side. If *Melonycteris* had not been separated from *Macroglossus* the present species might also have been left in *Macroglossus*. In size and in some of its characters it is intermediate between these two genera; but in other points it departs more from *Macroglossus* than *Melonycteris*. The tail, wanting in *Melonycteris*, has here two vertebræ more than in *Macroglossus*. The membrane on the foot, originating in *Macroglossus* from the fourth toe and in *Melonycteris* from the third, originates here with narrow bands from the third and second. The muzzle is still simpler than in either genus; the second premolar, both above and below, projects beyond the others; two posterior palatal folds are divided, as in *Melonycteris*, while they are not so in *Macroglossus*. As the tongue is as long as in the much larger *Melonycteris melanops*, Dobs. (*alboscapulatus*, Ramsay), and at the same time broad, I propose the generic name of *Megaloglossus*.

The species is dark brown, rather lighter on the body; total length from the muzzle to the interfemoral membrane 90, of the forearm 45, of the third finger 80 millim.

The species will be fully described and figured in the supplement to the Annual Report on the Museum for 1885.—*Zool. Anzeiger*, April 27, 1885, no. 193, p. 245.

On the Mode of Development of Cantharis vesicatoria. By M. H. Beauregard.

After three years of investigations I have the satisfaction of being able to present to the Academy the solution of a question which has hitherto remained a mystery. It has been attempted in vain to ascertain where *Cantharis vesicatoria* was developed, and whence came those dense masses of insects which annually settle upon the ash trees and completely strip them of their leaves.

When, in the course of the investigation that I have undertaken upon the tribe Vesicantia, I came to the question of the development of the *Cantharis*, M. Lichtenstein, of Montpellier, had succeeded by artificial rearing in demonstrating that the *Cantharis* passes through the various stages of *hypermetamorphosis*, and that its larvæ live upon honey. As he had only published very succinct descriptions, unaccompanied by figures, of the various states of the insect, I

was obliged to repeat these artificial breedings for myself. My experiments succeeded.

I then made excavations with the purpose of collecting the pseudochrysalis, the form under which the *Cantharis* winters. I soon found pseudochrysalides very like those of which I was in search, but which, on exclusion, furnished me with *Cerocoma Schreberi*, a vesicant beetle, the mode of development of which was also unknown. I had the honour to communicate these results to the Academy at its meeting of 21st July, 1884.

At the end of that year, in the beginning of December, I was enabled by the liberality of the Municipal Council to undertake another journey into the departments of Vaucluse and Gard. I returned to Aramon, when I had found the *Cerocoma*. I was attracted to that place by the exceptional abundance of the Cantharides. This locality is near Avignon. Some sandhills, which were worked some years ago and then abandoned, are frequented by numerous Hymenoptera, and form an excellent investigation-ground.

In the same mound in which I had found the *Cerocoma*, I collected, at a depth of more than 1 metre in the wall, some pseudochrysalides of large size and of a pale-straw colour, which I noticed in my book of observations as resembling in their various characters those which I had obtained in my artificial rearings. These pseudochrysalides were found in the midst of an innumerable quantity of cells of a Hymenopteron which I was able to determine, *Colletes signata*, and in the vicinity of cells of three or four times the size of another species of *Colletes*, the exclusion of which I have not yet obtained.

On my return to Paris with my booty I had the mortification to see a certain number of my pseudochrysalides gradually wither away, so that in the month of May I had only two left in good condition. At this period no appreciable change had taken place, when, on the 12th May, the integument of one of my pseudochrysalides split upon the back, and I saw issue from it a larva (the third larva of the Vesicantia), which, after three or four days of activity, fell into complete torpor. On the 26th May my larva changed into a pupa, and I could then, from the characters of the antennæ, head, and prothorax, assure myself that this time I was not in presence of the *Cerocoma*, and my anxiety became extreme. I compared it with the pupæ of *Cantharides* which I had artificially reared and preserved; there seemed to me to be no difference between the two forms. The following are the successive modifications that I observed.

The eyes acquire a brown and then a black tint; by degrees the mandibles become coloured; a very slight iridescent tint appears upon the head and then upon the prothorax. On the 5th of June the forehead and the articulations of the legs were coloured brown. The high temperature of the last few days assisting, the transformation was soon complete; the iridescent coloration gave place to a brown tinge and then to green, and I found myself in presence of a *Cantharis*. The individual is a male.

To sum up, I found the *Cantharis* in the midst of the cells of

various *Colletes*; it lives, therefore, in the larval state at the expense of those Hymenoptera.

Several reflexions deserve to be recorded here upon this matter :—

1. The pseudochrysalides, which I found in considerable numbers, were not enclosed in the cells of the Hymenoptera, but lay in their vicinity, in the sand. My rearings give me the reason of this fact, —I have always found (and M. Lichtenstein had also pointed this out) that the second larva of the *Cantharis*, after exhausting its provision of honey, buried itself in the soil, to become converted there into the pseudochrysalis. Things go on in nature as in my experimental tubes, and I find the pseudochrysalis among the sand, at a greater or less distance from the cell in which the larva lived as a parasite. This is a distinctive peculiarity which also belongs to the *Cerocoma*, and constitutes an important differential character with regard to the mode of development of *Sitaris* and *Stenoria*. The latter remain to the close of their evolution within the cells of which they have taken possession, and it is in these cells that we find these pseudochrysalides. The larvæ of *Cantharis*, like those of *Cerocoma*, are sufficiently powerfully armed to explain easily how, after having exhausted the provision of honey, they succeed in perforating the very thin wall of the cells of the *Colletes* in order to bury themselves in the sand.

2. I think I may repeat with regard to *Cantharis* what I said of *Cerocoma*. I have found the pseudochrysalis of *Cantharis* in the midst of the cells of *Colletes*, but I do not think that these Hymenoptera are the only ones capable of nourishing the parasitic larvæ. The various subterraneous Hymenoptera which provide their larvæ with a pasty honey may be indifferently the hosts of these parasites, and in proof of this I have the artificial rearings. M. Lichtenstein succeeded in rearing the larvæ of *Cantharis* by feeding them on the honey of *Ceratina*. I have also succeeded by means of the honey of *Megachile* and that of *Osmia tridentata*.

3. It seems probable, considering the comparatively small size of the cells of *Colletes signata*, that, in order to arrive at its full development, the *Cantharis* must consume the honey of several cells. It is easy to understand that this may be the case when one knows the voracity with which the larvæ of this insect devour honey and the activity that they display.

In conclusion, I shall record an experiment that I have made for the purpose of destroying once for all the idea put forward by Neutwich, who asserts that the vesicating power of the *Cantharides* is only developed after copulation. I have already shown that the cantharidine has its chief locality in the generative organs; and I have taken advantage of an opportunity that occurred to me of studying the action of those organs, with perfect certainty that there had been no copulation, since the insect had attained the perfect state under my own eyes. I therefore removed the generative organs from the insect on the 7th June at 11 o'clock in the morning, and applied them immediately upon my forearm after the method which I have already indicated. At 5 o'clock in the evening the apparatus was removed, and a considerable vesicle was soon developed. This experiment can leave no doubt as to the error committed by Neutwich.—*Comptes Rendus*, June 8, 1885, p. 1472.

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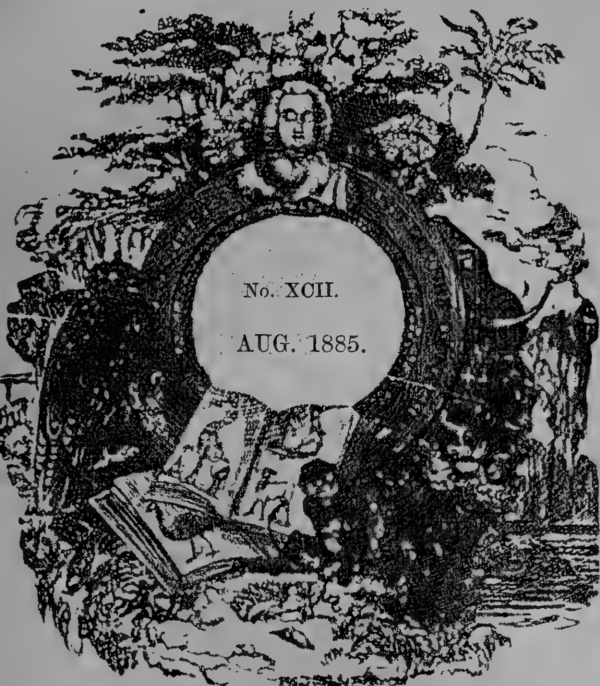

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THE ANNALS

AND

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[FIFTH SERIES.]

No. 92. AUGUST 1885.

VIII.—*Remarks on the Geographical Distribution of the Lacertilia.* By G. A. BOULENGER.

IN the present article I do not intend to give a detailed account of the geographical distribution of Lizards—a work which has to be postponed until the revision of all the genera and species is completed. But, general as these notes are, they will, I trust, be sufficient to establish an important fact, viz. the very great difference between the geographical distribution of Lizards and that of other groups of reptiles, and especially of the Batrachians, of whose distribution I have lately* treated.

The accounts hitherto given of the geographical distribution of reptiles were founded upon material chiefly derived from the works of Duméril and Bibron and of Gray. It has already been pointed out how artificial many of the systematic groups adopted by these authors are, and I have recently endeavoured to replace them by a more natural arrangement. No one will deny that a classification based on osteological as well as external characters must lead to a better understanding of the affinities of animals—affinities which are so frequently concealed under superficial appearances.

* Cat. Batr. Grad. &c. p. 105.

If we attempt to divide the globe as to its Batrachian fauna, two primary divisions present themselves, viz. a northern zone, comprising the Palæarctic and Nearctic Regions, and an equatorial southern zone. But for Lizards we have to draw a line from pole to pole, forming the Old World and Australia on the one hand, and America on the other, into primary divisions. And, proceeding to further subdivision, we find that the Ethiopian and Oriental or Indian Regions, which in their Batrachians are so closely related, have little in common as regards Lizards; whilst, on the contrary, the Oriental and Australian, so widely different in their Batrachians, are extremely similar. We find also that the Palæarctic or Europæo-Asiatic, the Batrachian fauna of which is so well characterized and without any affinity whatever to the Ethiopian, bears the closest resemblance to the latter region, differing only in the absence of various types which flourish in the tropical and subtropical zones. However, before proceeding to further remarks as to this division, I must give a synopsis of the ranges of the various families into which I have divided the order Lacertilia.

The two families Geckonidæ and Scincidæ may be left out, as, being composed of a very large number of genera which are distributed over the whole of the warmer parts of the world, they may be termed cosmopolitan. We must notice, however, that they both agree in being scantily represented in South America and abundantly in Australia. Dismissing also the small family Eublepharidæ, the extraordinary distribution of which (West Africa, Southern Asia from the Euphrates to Bengal, and Central America) is unparalleled, we retain the following families, which, owing to their more restricted range, throw greater light upon the subject. They may be divided into two groups: A. Small families, having a narrow range; B. Large and more widely distributed families:—

A. *Uroplatidæ.* Madagascar.
Pygopodidæ. Australia.
Xenosauridæ. Central America.
Zonuridæ. South Africa and Madagascar.
Aniellidæ. California.
Helodermatidæ. Mexico.
Xantusiidæ. California, Central America, and Cuba.
Gerrhosauridæ. Africa and Madagascar.
Anelytropidæ. Africa.
Dibamidæ. New Guinea.

B. *Agamidæ.* Most abundantly represented in the East Indies, less so in Australia, still less in Africa and

Asia north of the Himalayas. Absent from Madagascar and New Zealand.

Iguanidæ. America. Two genera in Madagascar, and another in the Fiji Islands.

Anguidæ. The bulk of this family occupies Central America and the West Indies, spreading to North and South America. One genus (*Anguis*) in Europe and the Mediterranean district, another (*Pseudopus*) represented by one species in the Mediterranean district and one in the Khasia Hills.

Varanidæ. Africa (excl. Madagascar), Oriental Region to Asia Minor, Australia.

Teiidæ. America.

Amphisbænidæ. Tropical and subtropical America, Africa (excl. Madagascar), and the Mediterranean district.

Lacertidæ. Africa (excl. Madagascar), Europe, Asia, few in the East Indies.

Chamæleontidæ. Africa, most abundant in Madagascar, one species, identical with a North African, extending to India and Ceylon.

Passing now to an examination of the relationships between the various parts of the globe as to their Lizard-faunas we must first establish the two great primary divisions which have been alluded to above, and which, in accordance with Mr. Sclater's nomenclature*, I will term the *Neogean* and *Palæogean* Realms. The former is characterized by the presence of the Iguanidæ, Teiidæ, and abundance of Anguidæ; the latter by Agamidæ, Varanidæ, Lacertidæ, and Chamæleontidæ. This division is the more natural, as we find in both realms, within their respective families, a repetition of the same forms having adapted themselves to similar conditions. Few more striking examples of parallel series of forms can be found than the families Agamidæ and Iguanidæ, or the Lacertidæ and Teiidæ. Such parallel series occur in almost every division of the animal kingdom: among the Batrachia we have the Arcifera and the Firmisternia; among the Chelonia the Cryptodira and the Pleurodira; and there can be no doubt that the indications furnished by the range of such analogous large groups are of the greatest importance in tracing the relationships of the faunas of the various parts of the world.

The Neogean Realm may, in this summary review, be described in few words. Its fauna is very uniform as

* Journ. Linn. Soc. ii. 1857, p. 130.

regards groups of higher rank, and the changes from the centre towards the North and South are very gradual. And it is noteworthy that the Central-American fauna (of which the North-American is but an offshoot) presents a greater variety of types than South America; thus it possesses representatives of every one of the eleven families which occur in the realm, viz. Geckonidæ, Eublepharidæ, Iguanidæ, Xenosauridæ, Anguidæ, Aniellidæ, Helodermatidæ, Xantusiidæ, Teiidæ, Amphisbænidæ, and Scincidæ; whereas South America lacks the small groups Eublepharidæ, Xenosauridæ, Aniellidæ, Helodermatidæ, and Xantusiidæ. As the greater abundance and variety of forms of the Anguidæ occurs in the northern half and the West Indies, and the reverse is the case as regards the Teiidæ (especially with reference to variety of genera) and the Amphisbænidæ, we may safely draw the boundary-line between two regions or subregions, as it may be thought fit to term them, at the Isthmus of Panama, the West Indies being comprised with the northern region. Lizards range only as far north as British Columbia (*Gerrhonotus cœruleus*), Minnesota (*Eumeces septentrionalis*), and Massachusetts (*Eumeces fasciatus*); whilst they have penetrated to the Straits of Magellan (*Liolœmus magellanicus*).

In the following remarks on the *Palæogean Realm* Wallace's zoo-geographical division is followed, with the view of examining how far it agrees with the facts deducible from the distribution of the Lacertilia.

1. *The Palæarctic Region.*—There is no more reason for separating this region from Tropical Africa than there is for separating North from Tropical America. Its chief character is the abundance of Lacertidæ, which group is also richly represented, by identical or closely allied genera, throughout the continent of Africa. In the Oriental Region they disappear, being eastwards represented only by the aberrant genus *Tachydromus*, which is an Oriental form.

In Europe and the Mediterranean district Anguidæ occur, represented by two genera, viz. *Anguis*, which has its nearest ally in *Ophiodes* of South America, and *Pseudopus* (of which a second species is found in the Khasia hills), closely related to *Ophiosaurus* of North America. The occurrence of these American types is analogous to that of the Batrachian genus *Hyla* in the same region, and the fact that the Khasia hills are also the home of a distinct species of that genus is extremely remarkable; but this is the only analogy that can be found between the Batrachian and Lacertilian faunas of the Palæarctic Region. The Mediterranean districts of Africa and Asia, as well as the tract extending to North-western India,

are characterized by a mingling of European and Ethiopian forms, with, however, strong predominance of the latter—the true *Lacertæ* being outnumbered by such forms as *Eremias*, *Acanthodactylus*, &c., and the families Agamidæ, Amphisbænidæ, and Chamæleontidæ being represented by a greater or less number of species. The homogeneity of the desert-fauna which extends from North-west Africa to Sind is striking; not only the genera remain nearly the same, but even some of the species are identical throughout or but slightly modified.

African forms, such as the Lacertoid genera *Eremias* and *Scapteira*, penetrate into Central Asia and Mongolia; the genus *Phrynocephalus*, so characteristic of that district, is but a slightly modified form of the African *Agama*. By the abundance of these types, and by the absence of the genus *Lacerta** and the Anguidæ, the interior of Asia differs strongly from Europe, without showing any relationship to the Oriental Region; its character is essentially African. The Manchurian Subregion shows a decided preponderance of Indian forms, as is rendered especially apparent by the presence of several species of the genera *Gecko* and *Tachydromus*, which are otherwise restricted to the eastern parts of the Oriental Region, extending far into the Indian archipelago, but not ranging west of Bengal. Japan, with the widely-distributed genus *Eumeces* and the genera *Gecko* and *Tachydromus*, is without any affinity whatever to the Palæarctic Region—a fact in accordance with the distribution of Ophidians, as shown by Dr. Günther †, but different from that of Batrachians. The Manchurian Subregion is therefore to be included in the Oriental Region. The northern limit of the Lacertilia in Asia is still to be ascertained; in Europe they are known to occur as far as Lapland (*Lacerta vivipara* and *Anguis fragilis*).

2. *The Ethiopian Region.*—The affinity between this and the preceding region is so great, and the passage between the two so gradual, that it is hardly possible to draw any satisfactory boundary-line; should such a boundary have to be traced, the southern limit of the Sahara appears to be the most natural. The south of the African continent exhibits by far the most varied Lizard-fauna, no less than ten families (viz. Geckonidæ, Agamidæ, Zonuridæ, Varanidæ, Amphisbænidæ, Lacertidæ, Gerrhosauridæ, Scincidæ, Anelytropidæ, and Chamæleontidæ) being represented, the smaller of which

* A single species, *Lacerta vivipara*, ranges far to the east in Northern Asia, its presence being recorded in Amoorland; how far *L. agilis* extends into Siberia is unknown at present; no other *Lacertæ* are known to occur in Siberia.

† Proc. Zool. Soc. 1858, p. 379.

(Zonuridæ, Gerrhosauridæ, Anelytropidæ) gradually disappear towards the north. As Africa shows some points of relation to Tropical America in certain Batrachians, such as the Aglossa, the Cæcilian genus *Dermophis*, so a point of similar affinity is suggested by the Amphisbænidæ, of which eight genera occur in Africa and five in America, two being common to both regions. The distribution of the Lacertilia does not afford any support to the divisions into the continental subregions proposed by Wallace. Madagascar is as differentiated from continental Africa in its Lizards as in its Batrachians, although it has less in common with the Oriental Region; we find likewise strictly American forms (the Iguanoid genera *Hoplurus* and *Chalarodon*) and a striking negative feature in the absence of such families as the Agamidæ, Amphisbænidæ, and Varanidæ; it possesses a peculiar family—the Uroplatidæ. The sole point by which affinity to the Oriental Region might be thought to be indicated consists in the presence in the Andaman Islands of a species of the Geckoid genus *Phelsuma*. But Madagascar has important elements in common with Africa, viz. the Chamæleontidæ (represented by twenty-four species, nearly half the number actually known), Gerrhosauridæ, and Zonuridæ. It should therefore be regarded as a subregion of the Ethiopian Region, having much in common with the latter, a little with South America, scarcely anything with the East Indies, and nothing with Australia.

It is remarkable that this region is relatively poor in arboreal lizards, these being almost exclusively represented by the Chameleons. The Agamoids, so rich in arboreal forms in the Oriental Region, are terrestrial in Africa (*Agama*, *Aporoscelis*, *Uromastix*), and so are also the few Iguanoids of Madagascar.

Although the distribution of minor groups is beyond the scope of this paper, the range of a few genera may be noticed, as affording strong support to the views advocated on the relationship of the Ethiopian and Palæarctic Regions.

1. *Lacerta*. Three species in South Africa, four in Tropical Africa, about twelve in Europe and the circum-Mediterranean district.
2. *Tropidosaura*. Two or three species in South Africa, three in the circum-Mediterranean district.
3. *Eremias*. Numerous throughout Africa and South-western and Central Asia and Mongolia.
4. *Scapteira*. Two or three species in South Africa, two in Central Asia.

5. *Chalcides* *. Ten species in Madagascar, one in South Africa, six in the circum-Mediterranean district.

3. *The Oriental Region.*—We have seen above that the Manchurian Subregion of the Palæarctic Region should form part of the Oriental. The northern boundary traced by Wallace appears otherwise satisfactory, save that the desert of North-western India belongs essentially to the Ethiopian Region. This region thus defined is poor as regards the number of families: these are the Geckonidæ, Eublepharidæ (in India only), Agamidæ, Varanidæ, Lacertidæ, and Scincidæ. We have noticed above the occurrence of *Pseudopus* (Anguidæ) in the Khasia hills.

It possesses also a representative of the Chamæleontidæ in India and Ceylon; but the fact that this unique species is identical with a North-African one clearly shows that it must be treated as an immigrant from the Ethiopian Region. For the same reason we may omit such genera as *Agama* and *Uromastix*, which occur in Northern India, and the Lacertoid genera *Ophiops* and *Cabrita*, which are merely outposts from the neighbouring region. The Lacertidæ, therefore, are restricted to a single Oriental genus, *Tachydromus.* The Geckonidæ and Scincidæ are cosmopolitan; the Eublepharidæ have such a range as to throw no light on the relationships of this with other regions; and, finally, the Agamidæ and Varanidæ occur in common with the Ethiopian and Australian Regions. The Oriental Region does not possess a single family of its own, a fact already pointed out for the Batrachians. The Agamoids, by the great number of genera, most of which are adapted to arboreal life, give a special feature to this region, especially when compared with Africa and Australia. The subdivisions into subregions proposed by Wallace appear to agree on the whole with the distribution of the Lacertilia; but this is a question that can only be elucidated by discussing the range of genera and species, and therefore does not fall within the scope of this preliminary note. As to the eastern limit of the Oriental Region, it is by no means easy to decide where it should be drawn. Wallace's line clearly does not answer in this case, for Celebes and the Moluccas are tenanted by a strictly Malayan lizard-fauna, without Australian element. The latter begins to appear in New Guinea, where the genera *Draco* and *Calotes* are absent; whilst the characteristic Australian family Pygopo-

* = *Seps*, auct. nec Laur., + *Gongylus*.

didæ is represented in its southern parts; this great island must be regarded as the debatable ground between the Australian and Oriental Regions. But, as observed above, there is, as regards the Lizards, no fundamental difference between the two; they form a single great region, which may be divided into several subregions, but not into two primary divisions, as required for other groups of animals.

4. *The Australian Region.*—Only five families occur—two cosmopolitan (Geckonidæ and Scincidæ), two in common with Asia and Africa (Agamidæ and Varanidæ), and one characteristic (Pygopodidæ). In New Guinea occurs the small family Dibamidæ; and the Fiji Islands possess a genus of Iguanoids, *Brachylophus*, the nearest ally of which is perhaps the West-Indian *Cyclura*. The bulk of the fauna consists of the Geckonidæ and Scincidæ. The latter, as regards number of species and variety of forms are not surpassed or even equalled in any other part of the world, and the former are well represented, although less so than in the Oriental Region. In the islands of the South Pacific, New Zealand included, these two families only are found, but represented by numerous species, some of which are types of peculiar genera, usually showing but remote affinity to the continental forms. The Agamoids are mostly terrestrial, some semi-arboreal and semiaquatic. Special affinity with the Oriental Region is shown in the genera *Physignathus* (four species in Australia, two in Siam and Cochin China) and *Gonyocephalus* (numerous throughout the Malayan and Papuasian islands, two species in Queensland). One of the most remarkable features of Australia is the small number of families, it being in this respect inferior to Europe, which possesses representatives of seven, a remark which applies also to the Batrachians, of which Australia has four families and Europe seven.

Thus we arrive at the conclusion that the zoo-geographical regions generally in use, and especially their degree of relationship to one another, receive little support from the study of the distribution of Lizards; that the distribution in zones, which is so satisfactorily shown by the Batrachians and the freshwater Fishes, is contrary to the plainest evidence as regards Lizards, which at the present time range more according to longitude; that the two great divisions originally proposed by Mr. Sclater, and derived from the study of passerine birds, hold good; and that, if a division of the world had to be framed according to the lizard-faunas, the primary divisions would be the following:—

I. *Palæogean Realm.*

Two regions:—1. *Occidental* (=Palæarctic Region, excl. the Manchurian Subregion, + Ethiopian Region of Wallace); 2. *Oriental* (=Oriental + Australian Regions of Wallace).

II. *Neogean Realm.*

Nearctic + Neotropical Regions.

IX.—*Second List of Reptiles and Batrachians from the Province Rio Grande do Sul, Brazil, sent to the Natural-History Museum by Dr. H. von Ihering**. By G. A. Boulenger.

The following species, which were not contained in the first list, formed part of a large collection made by Dr. von Ihering at S. Lorenzo, on the southern border of the Lagoa dos Patos. As before, such species as have not been recorded from Rio Grande do Sul by Hensel are marked with an asterisk.

REPTILIA.

Chelonia.

*1. *Hydromedusa tectifera*, Cope.

Hydromedusa Maximiliani, Wagler, 1830, nec Mikan.
Chelodina Maximiliani, Dum. & Bibr. 1835.
Hydromedusa tectifera, Cope, 1869.
Hydromedusa platanensis, Gray, 1873.
Hydromedusa Wagleri, Günth. 1884.

Two specimens, adult male and young. In the latter, the nuchal is in contact with the first costal, whilst in the former it is so on one side only—a fact which justifies the view expressed in the above synonymy.

*2. *Thalassochelys caretta* (L.).

Lacertilia.

Anisolepis, g. n. Iguanidarum.

Tympanum distinct. Body cylindrical; no dorso-nuchal crest. Dorsal lepidosis heterogeneous, keeled; ventral scales

* *Cf.* Ann. & Mag. Nat. Hist. ser. 5, xv. pp. 191–196.

large and keeled. A strong transverse gular fold; no gular sac. Head-scales small. Digits subcylindrical, with smooth lamellæ inferiorly. No femoral pores. Tail long, round. Lateral teeth tricuspid; no pterygoid teeth. No sternal fontanelle. Abdominal ribs.

Allied to *Enyalius*, *Urostrophus*, and *Liosaurus*, which have likewise smooth infradigital lamellæ, no femoral pores, and, like *Polychrus* and the Geckonidæ, abdominal ribs and no fontanelle in the sternum.

*3. *Anisolepis Iheringii*, sp. n.

Head small, body elongate. Nostril lateral, near the end of the snout; ear-opening moderately large, oval. Upper head-scales small and smooth, smallest on the supraocular region; occipital enlarged, suboval, about as large as the tympanum; upper labials eight, very low. Gular scales granular and keeled medially, larger and smooth anteriorly, gradually larger, rhomboidal, imbricate, and strongly keeled towards the gular fold, which is strong and straight. Median dorsal scales larger, irregular, imbricate, strongly keeled, the largest forming one or two indistinct longitudinal series on each side of the vertebral line; dorso-lateral scales very small, granular, keeled, unequal, intermixed with irregularly scattered enlarged scales. Ventral scales much larger than dorsals, equal, rhomboidal, imbricate, strongly keeled, the keels forming straight longitudinal series. The adpressed hind limb reaches the axilla or the shoulder. Tail more than twice as long as head and body, covered with equal keeled scales. Olive-brown above, with a series of triangular dark brown spots on each side of the vertebral line, forming a zigzag band; this is bordered externally with yellowish or reddish; the triangular spots may send forth narrow dark brown lines obliquely directed posteriorly down the sides; lower surfaces yellowish or coppery, the throat with a few blackish dots or longitudinal lines; tail above with a series of rhomboidal, dark, light-edged spots.

	millim.
Total length	245
Head	15
Width of head	10
Body	54
Fore limb	27
Hind limb	41
Tail	176

Two female specimens.

*4. *Mabuya dorsivittata*, Cope.

Originally described from Paraguay. Specimens from Uruguay are also in the Natural-History Museum.

OPHIDIA.

*5. *Geophis reticulatus*, sp. n.

Internasals not larger than postnasals; frontal broader than long; no preocular; two postoculars; seven upper labials, third and fourth entering the eye; temporals 1+2. Scales in fifteen rows. Ventrals 156; caudals 26. Pale brownish above, each scale edged with dark brown; an ill-defined dark brown collar; lower surfaces uniform whitish. Head and body 315 millim.; tail 40 millim.

A single specimen.

*6. *Ablabes Agassizii* (Jan).

Eirenis Agassizii, Jan.

Several specimens, representing two varieties of coloration. One is olive-grey, with the bands along the body very indistinct; the other is brown on the sides, with a whitish black-edged streak on each side of the back, which is brick-red between them. A specimen from Uruguay in the museum agrees perfectly with Jan's figure.

7. *Tomodon dorsatus*, D. & B.

8. *Herpetodryas carinatus* (L.).

*9. *Leptognathus ventrimaculatus*, sp. n.

Habit moderately slender, compressed. Internasals not half the size of the prefrontals; frontal as broad as long, about two thirds as long as the parietals; nasal undivided; loreal not twice as long as high, largely entering the eye; a small preocular may be present above the latter shield; two postoculars, upper largest; six upper labials, fifth largest, third and fourth entering the eye; lower labials eight, five anterior in contact with chin-shields; temporals 1+2. Scales smooth, in fifteen rows, the vertebral enlarged, hexagonal. Ventrals 156 or 161; caudals 45 or 48. Body with blackish-brown, large, transverse spots, or with two alternating series of such spots, separated by narrow pale brownish or whitish intervals; head blackish brown, veined with brownish white;

lower surfaces whitish, largely spotted with black. Head and body 360 millim.; tail 90 millim.

Two specimens.

10. *Bothrops alternatus*, D. & B.

Bothrops atrox, Hensel (part. ?).

*11. *Bothrops biporus*, Cope.

BATRACHIA.

*1. *Paludicola fuscomaculata* (Steind.).

*2. *Limnomedusa macroglossa* (D. & B.).

*3. *Phyllomedusa Iheringii*, sp. n.

Very closely allied to *P. Burmeisteri*, but the head is smaller, not wider than the body, the snout less obliquely truncate, and the parotoids are scarcely prominent. The coloration is also different. Upper surfaces, the digital disks included, green; concealed parts of the body and limbs bright orange, with dark purple lines forming vertical bars or a wide-meshed network; a more or less distinct whitish line round the lower jaw and along the outer side of forearm and hand and tarsus and foot; lower surfaces pale yellowish, or grey spotted with yellowish. Male with an internal subgular vocal sac and blackish rugosities on the thumb. From snout to vent 67 millim.

Numerous specimens.

X.—*On the "Tag" of* Cœlopleurus Maillardi, *Mich.* By Prof. P. Martin Duncan, F.R.S.

The "tag" of an Urchin is that comparatively bare space on the test which is situated above, that is aborally to, the branchial slit or "cut."

It is a small, elongate, narrow space just on the edges of an interradium and an ambulacrum, and the ambulacro-interradial suture usually runs down it. As there are ten slits or cuts, there may be as many "tags." The structure is by no means universal, and there are groups of genera in which it does not exist. Mr. Percy Sladen and myself found the tag well

developed in the fossil *Cœlopleuri* of the Tertiaries of Western India (Pal. Indica, ser. xiv., "Fossil Echinoidea of Sind"); and in investigating the morphology of the recent *Cœlopleurus Maillardi* I found evidences of the function of the region. I have not had an opportunity of examining the structures upon any other recent form, and possibly the description now given may stimulate other students of the Echinoidea to add to our knowledge.

Dr. Günther was so good as to allow me to study one of the specimens of *C. Maillardi* in the British Museum, and the preparation which forms the subject of this short description will shortly be in the possession of the museum. A portion of the test around the peristome was cut away, so as to include a branchial cut and a tag, and the peristomial membrane which is attached to the edges of the test was carefully separated. The piece of test was then placed in nearly absolute alcohol. After the lapse of a few days the tissue on the tag, which was in organic contact with the test beneath, was separated, floated off, and stained with eosin, cleared in oil of cloves, and mounted in balsam.

The base of the structure is a reticulate, perforate, and more or less broadly spiculate calcareous layer or layers, and the nucleated soft structures environ the hard parts. The surface consists of connective tissue, minute nucleated cells showing evidences of cilia, and extremely fine nerve-filaments. In three places this common ectodermal structure became thick and rose into three small bodies, each of which has a broad base and a surface of digitiform and sometimes ragged processes. The surface of each of the bodies is highly nucleated, but no trace exists of a central canal, and, indeed, the appearance given is that of solidity.

The three bunches of tissue are eminently branchial in their appearance, and, so far as I know, resemble in their construction the branchiæ on the peristomial membrane. Unfortunately these last structures in *Cœlopleurus* are so covered with pigment bodies—which are not quite absent, moreover, from the bodies on the tags—that a satisfactory preparation of them has yet to be made.

There does not appear to be any connexion between the bodies on the tag and the water-system of the ambulacra, and probably they act as respiratory organs by increasing the surface of the common derm.

XI.—*Remarks on the Cœlenterate Nature of the Sponges.* By WILLIAM MARSHALL *.

ON different occasions I have given expression to my conviction that the Sponges are Cœlenterata—a conviction which I share with Leuckart, Häckel, Von Lendenfeld, and others. It originates from a series of morphological and ontogenetic facts, of which radial symmetry is not the least important. I have formulated my opinion about as follows:—that the Sponges are Cœlenterata, in which, in consequence of the (phylogenetically speaking) very early occurrence of sessility, profound retrogressions had taken place, induced especially by a colossal overgrowth of the mesoderm.

Quite recently treatises have appeared from two sources on the systematic position of the Sponges. One of them (which certainly completely ignores my conception and its results) argues against the Sponges belonging to the Cœlenterata, and indeed to the Metazoa at all; while the other arrives at the result that, if the Sponges and Cœlenterata did possess common ancestors, the former must have branched off from the latter at a time when true typical Cœlenterate characters had not yet been acquired. As both treatises have distinguished spongiologists for their authors they call for the greatest consideration; and this the more, because they diverge so widely from each other in the result of their deductions. One of these memoirs is the work of F. E. Schulze †, the other of W. J. Sollas ‡; and although the former appeared somewhat later than the second, we shall here discuss it first, as its treatment of the subject is more general.

Schulze subjects the two opposite opinions—according to one of which the Sponges are colonies of Protozoa (Choanoflagellata), and according to the other Cœlenterata—to a thorough criticism.

Following the lead of James Clark and Carter, Savile Kent especially, with whom Bütschli has also recently associated himself, had taken it upon himself, on the foundation of observations partly correct, but partly also quite erroneous, to demonstrate the Protozoan nature of the Sponges, in which he laid particular stress upon the nature of the flagellate cells and the processes of development. The flagellate cells, when

* Translated from an advance copy, communicated by Dr. G. J. Hinde, F.G.S., of the paper in the 'Jenaische Zeitschrift,' Band xviii. pp. 868–880.

† Sitzungsb. Berl. Akad. d. Wiss. 1885, pp. 179–191; translated in Ann. & Mag. Nat. Hist. ser. 5, vol. xv. pp. 365–377 (May 1885).

‡ Quart. Journ. Microsc. Sci. n. ser. vol. xxiv. pp. 603–621.

fully developed, have, like the Choanoflagellata, a peculiarly differentiated frill (collar), which surrounds the basal part of the flagellum like a funnel, and also pulsating vacuoles in the interior. According to Kent the ciliated cells of the free-swimming larvæ also show the same characters; but this unfortunately has been seen by no one but himself.

Schulze, indeed, admits that it would seem hardly natural to suppose that so peculiar a structure as the collar of the flagellate cells had originated spontaneously twice in different groups of animals; but that it is to be regarded as inherited by the more complex, and therefore probably more recently differentiated form, from the simpler and therefore probably older form; but upon the whole he finds that, even if we leave out of consideration a series of differences, which certainly exist between the Choanoflagellata and flagellate cells of Sponges, it would not be a justifiable conclusion to deduce from a similarity, however close, of unicellular Protozoa with certain cells of the *trilamellate* Sponges, that the latter pertained to the former. Moreover, in reality, in the blastula of the Sponges flagellate cells of this kind, furnished with collars, are always deficient, although their presence there might justly be expected, if they originated from the *Choano*flagellata. After taking the trouble to examine how Savile Kent could have come to the erroneous assumption of the presence of the collar in the ciliated cells of the sponge-larvæ, Schulze arrives at the conclusion that the Sponges are true Metazoa, for they have sexual reproduction, and in their larvæ two different cell-layers, an outer and an inner one, may be clearly distinguished.

Schulze then discusses the hypothesis of the Cœlenterate nature of the Sponges. To the radiate structure occurring occasionally in larvæ and also in adults he ascribes no great importance; the Ascones never formed radial diverticula of their central cavity, and if these were produced in Sycones as sacciform distensions of the body-wall, it must be borne in mind that the Sycones before they formed the radial tubes possessed ontogenetically the pure type of the Ascones, so that the latter must consequently be regarded as ancestors of the former. Hence it seems very probable that the most ancient sponge-forms possessed an *Olynthus*-like form without radial diverticula of the central cavity; and the developmental history of the Sponges, so far as we are yet acquainted with it, presents no sufficient ground to justify the assumption put forward by me of common ancestors of the Sponges and Cnidaria, with radially arranged mesenterial pouches, tentacles with urticating capsules and indifferent aquiferous pores. It may be true that the difference between the free-swimming larvæ of

the Sponges, on the one hand, and the Cnidaria, on the other, is, on the whole, not more important than that between the various Sponge-larvæ among themselves. But as the fundamental differences in the structure of the two groups only showed themselves after the metamorphosis, we are justified in the assumption that the divergence of the two lines did not begin before that phylogenetic developmental stage which represents the ciliated larva on the point of metamorphosis.

Sollas takes quite a different standpoint, as strikes one at once on reading the proposition that he places at the head of his argument, namely, that it is difficult to suppose that such complicated structures as the collared flagellate cells of the Sponges could so closely resemble the Choanoflagellata, and at the same time be of independent origin. He explains the metazoic character of the Sponges, using Lankester's term, as "homoplastic," and their Infusorian character as phylogenetic, *i. e.* he believes the latter to be inherited, the former newly acquired. He proceeds:—Only two characters of the Sponges are essentially of metazoic nature, namely, the presence of both kinds of sexual reproductive bodies and of a gastrula. As regards the former, we find also in plants two kinds of sexual products, and what plants and animals could have formed independently of each other Sponges and Cœlenterata might also have acquired independently. In opposition to the second character, the formation of the gastrula, it is to be remarked, in the first place, that the flagellate cells of the habit of the Choanoflagellata occur very early in the ontogeny of the Sponges, at least before the formation of this gastrula, as is clearly the case in the amphiblastula of *Sycon raphanus*. Secondly folding, and therefore the formation of a gastrula, is one of the most frequent of all processes in the different developmental processes of animals, and is probably easily explicable by a simple mechanical process. So much, at least, is certain, that foldings in numerous cases originate quite similarly and independently of inheritance, and may lead to the foundation of organs which may indeed be "homoplastic," but certainly not homologous. Further, we see that the formation of a gastrula in Sponges, as also in Cnidaria, may take place in two ways, namely, by invagination and by cleavage of the mesenchyma, and one or other of these two modes at least cannot be explained by inheritance. Once more asserting the early occurrence of the cells like Choanoflagellata in the sponge-larvæ, Sollas comes to the conclusion that the Sponges may have developed themselves independently as a special phylum from the Choanoflagellata, and he proposes to separate them from the Metazoa under the name of "Parazoa."

Moreover, the gastrula of these Parazoa differs sufficiently from that of the Metazoa in the fact that in it the hypoblast (endoderm) consists of cells provided with collars.

This is essentially the course of Sollas's argumentation. It will be seen from it that he lays the chief stress upon the presence of the cells furnished with collars in the sponge-larvæ, and according to him they occur particularly in the amphiblastula of *Sycon raphanus*. I do not know whether Sollas has himself observed these collars in this case; except Kent, as already mentioned, no mortal has yet seen them; and so competent a judge as Schulze says * :—"In my investigations of the swarm-larvæ of *Sycandra raphanus*, which can hardly differ essentially in the structure of its larvæ from *Sycandra compressa*, and of many other sponge-larvæ, I have endeavoured, always in vain, to discover anything like the collar at the free extremity of the cylindrical flagellate cells." And he then shows very plausibly in what manner Kent's mistake may have originated.

My observations, which appear to agree with those of most other investigators, have shown me that flagellate cells always make their appearance in the canal-system of the Sponges only when a current of water through the body of the animal is possible, *i. e.* after the appearance of a gastro-vascular system with a double communication outwards. The flagellate cells are nothing but specially differentiated endodermic cells, which originally have exactly the same appearance as all the rest. This differentiation is due to division of labour: while the flat endodermic cells chiefly effect the inception of nourishment, the flagellate cells, by means of their flagella, produce an energetic circulation of water through the body of the sponge, and, chiefly by means of their collar, effect respiration. As in an Infusorian, an egg-cell, &c., the clear respiratory plasma † collects as much as possible superficially, and turned towards the point of access of the oxygen, so also in the flagellate cells of the Sponges, both in those of the swimming-larvæ and in those of the flagellate chambers. But while in the former the surface is more than sufficient for the reception of a sufficient quantity of oxygen, in the flagellate cells the case is different. They are therefore compelled to enlarge their respiratory surface. But where can this be done? Only where the cells come into contact with the water containing the oxygen. The rest of the body is more or less wedged in

* *Loc. cit.* p. 182 (Ann. & Mag. Nat. Hist. *loc. cit.* p. 368).

† See A. Brass, 'Biologische Studien, Th. I. Organisation der Thierischen Zelle,' pp. 64 and 150.

and enclosed between other tissue-elements; it is therefore the upper extremity, in which the clear respiratory plasma has collected, that is compelled to free itself from obstructive surroundings; the cell therefore loses its purely prismatic form and acquires a process which is accessible to the water on all sides. But this alone does not suffice, even if it widens upwards; it is compelled to enlarge its surface still more, and this is effected by its quitting its simple cylindrical or conical form and becoming converted into a funnel. This does not imply, as previous observers have sometimes stated, that the flagellate cells could not take in nourishment, but, as we see from the other endodermic cells, for that purpose they need not acquire a collar. Thus in my view there exists a very essential difference between the functions of the collar in the flagellate cells of the Sponges and in the Choanoflagellata, of which latter Bütschli remarks *:—"There is unanimity among observers that the collar, at least in the Cryptomonadina, is an organ connected with the reception of food."

In this way I come to the conclusion that the Flagellata and the flagellate cells of the Sponges absolutely stand in no phylogenetic connexion, but that the two peculiarities, which agree so remarkably, are due rather to adaptations *sui generis*. The flagellate cells of the endoderm of the young sponge, probably even in one which has originated from an amphiblastula, are not at once to be identified with the flagellate cells of the larva; first of all the flagella disappear, and then (after the cell has become flattened as an endodermic cell, and then again extended with a fresh accumulation of the clear respiratory plasma at the free pole), so soon as the flow of water becomes possible, they again make their appearance together with the collar; in the sponge-larvæ in which the endoderm is formed by division of the cœnoblastema—and these are probably the majority—there can be no question at all of any such connexion.

While I am perfectly in agreement with Schulze in denying any relationship between the Sponges and Choanoflagellata, our views with regard to the degree of relationship between the Sponges and Cnidaria are, as already remarked, very divergent, and I will now endeavour to support and establish my opinion in opposition even to such serious objections as Schulze puts forward.

As we have already seen, Schulze, while placing the ontogenetic processes in Sponges in the first line, as justly required

* Bronn's 'Klassen und Ordnungen,' Neue Bearb. Bd. i. p. 885.

by modern ideas, finds no sufficient grounds, in what we at present know of these, for ascribing, as I have done, to the common ancestors of the Sponges and Cnidaria radially arranged mesenterial sacs, tentacles with urticating capsules, and indifferent aquiferous pores. In opposition to this I might indicate that I have not definitely assumed the existence of the tentacles and urticating capsules, but I say * :—"*It may be difficult to ascertain whether the Sponges are or are not retrogressive as regards these organs* (*i. e.* urticating organs) *and the tentacles*; but in the attempt to demonstrate the Cœlenterate nature of the Sponges this is not of preeminent importance;" and further, "In case the ancestors of the Sponges ever possessed tentacles and urticating organs it is not difficult to understand how these might have been lost;" and, finally, "*It is indeed not impossible that the Sponges branched off at a developmental stage of the Cœlenterate stem, at which tentacles and urticating organs had not yet been differentiated.*"

Hence there remain two points, namely the radiate structure and the canal-system, which chiefly determine me to see Cœlenterates in the Sponges; and it may perhaps not be superfluous to discuss these characters here in detail.

In the first place we have to attempt to answer the question, How did the radiate symmetry of the Cœlenterata originate? The literature that deals with this subject is not considerable. There exists, indeed, a whole series of books and memoirs in which one would expect *à priori* to find statements relating to it; but they refer to the radiate structure in general, and do not enter upon its origin. Properly speaking Leuckart † alone has spoken in various places in some detail upon this point, and we shall therefore on the whole adopt his guidance in what follows.

If we imagine a creature of spherical, discoidal, conical, or cylindrical form, swimming (but entirely in the water, not at its surface), this, supposing it to possess a body composed of perfectly homogeneous substance, will always find itself in equilibrium. If we imagine, further, that the substance of the body does not remain homogeneous, that, for example, a heavier part is differentiated, this will place itself either exactly centrally, *i. e.* axially, or it must form a uniformly developed mantle around the lighter part. Or the substance

* Zeitschr. für wiss. Zool. Bd. xxxvii. p. 244.

† In various places in his 'Jahresberichte,' and, further, in his tract 'Ueber die Morphol. &c. d. wirbell. Thiere,' p. 14, and especially in Bergmann and Leuckart, 'Anat. physiol. Uebers. d. Thierreichs,' pp. 392 *et seqq.*

may break up into any number of parts, and then these, if they are not to disturb the equilibrium, must always collect in such a manner that every plane drawn longitudinally through the creature may divide it into two halves of equal weight and of the same structure. If the divisional parts are all of equal size, the mass of cells, except when it is of a conical form, has no anterior or posterior, superior or inferior, part founded on structure (although perhaps on movement) (*Blastula*). It is otherwise, however, when the divisional parts are of different sizes and of different weights, and are not sufficiently numerous for one set of them to group themselves round the other as a continuous mantle; then the larger ones, in order to preserve the equilibrium, as also the smaller ones, will arrange themselves in a particular manner (*amphiblastula* of *Sycon*), and in this way special regions of the body will orientate themselves. That at the same time a cavity may be formed by separation in the interior of the regularly constructed cell-aggregate, and that this may become filled with water, is of no consequence if only the parts of the wall remain in equilibrium. Matters remain the same if this cavity breaks through outwards, or if a portion of the hollow sphere becomes invaginated; whether a swimming-gastrula forms a central cavity by invagination or by perforation, its mouth must be placed centrally and the parts of the wall must arrange themselves around it and the primary stomachal space, so that here also the equilibrium remains intact. So soon as special organs become differentiated in our animal, even without its acquiring a definite permanent position of the direction of movement necessitating the distinction of upper and lower, right and left, and whether these organs are such as aid in the taking of food (tentacles), or complications of the digestive cavity (mesenterial sacs, gastral canals), or sexual organs, &c. &c., the central place being already occupied by the primordial stomachal space, these must always place themselves peripherally, occur in plurality, and group themselves in such a manner that the animal does not lose its equilibrium. In this way the radiate structure of the primitive swimming Cœlenterata was brought about. There is, however, another point that must not be overlooked in these considerations. A radiate structure is not only of great service, indeed to a certain extent indispensable, to free-swimming creatures of spherical or cylindrical form &c., on account of the stability of equilibrium, but it may also be of great importance to sessile forms, inasmuch as, acting externally, it harmoniously increases the power of resistance in all directions; we construct not only our air-balloons on the radiate type, but also

our towers and other fortifications. In these considerations I have left the Echinodermata out of the question. They and the Cnidaria are only distantly related; the two classes have acquired the radiate structure independently of each other, and it shows essential differences in them. If I divide a typical Echinoderm (with the fundamental number five) by a polar plane into two equal halves, so that the plane on my side, as far as the central point, halves a radius, it will halve an interradius on the other side of the central point; but in typical Cœlenterata (with the fundamental number four) I shall under similar circumstances always halve similar parts.

There is no doubt that free, moving Cœlenterata are more ancient than attached ones, just as all sessile animals, which are only conceivable in water, are descended from swimming forms. The inducement to adhesion lies in the impulse more or less inherent in all animals to save themselves labour and bodily exertion as much as possible, and it could only be given when such a superfluity of food occurred that the animals needed to take absolutely no trouble in seeking it. When we see that the polyps, even when they are adherent, as so many have been for a long time, have retained the tentacles and the radiate structure, we must assume that these are of preeminent importance; and this I believe to be the case especially with the tentacles, which, together with the urticating organs, play so important a part in the obtaining of nourishment. The other radiality may rather be secondarily retained, perhaps in correlation with the tentacles (as frequently, *e. g.* in *Hydra*, the radiate structure finds expression only in those organs); at least it is precisely in adherent forms, *i. e.* in those without free locomotion, that it is interfered with more frequently than in others in favour of an incipient bilateral symmetry (Fungidæ, *Flabellum*, developmental stages of corals, Hydroida, &c.). In the origination of an incipient bilateral symmetry another incident probably cooperates, at least in part, namely regular currents of water; an adherent radiate animal when growing in a constant current of water must naturally develop especially *one* axis, that which lies in the direction of the constant current, for in this way alone it offers the greatest resistance with the smallest expenditure of force (growth-energy). A further consequence of sessility is the possibility of an increased development of the mesoderm, especially the formation of heavy skeletal masses.

As soon as a change of function took place with the gastro-vascular apparatus, as in the Sponges, as soon as the nourishment was taken up by it, the tentacles, if they had

already been differentiated at all, were lost in all cases, and the radiate structure in most cases, and finally the mesoderm increased in growth to such an extent that, under certain circumstances, the stomachal space and the buccal aperture disappeared. That the ancestors of the Sponges were not for very long, if at all, provided with tentacles, which, indeed, are only secondary, may be readily admitted, but *they were at least bilamellar, and at the same time, as we may conclude from the retrogressions which continually occur, radiate; they had a buccal aperture and a stomachal space, from which gastral canals ran radially to open freely outwards, breaking through the ectoderm; and such creatures, to my mind, are under any circumstances true Cœlenterata.*

When Schulze refers to the developmental processes in *Sycon*, and comes to the conclusion that it is probable that the oldest sponges possessed no radial diverticula of the gastral space, but, like *Olynthus*, had a simple saccular form, we might point out in opposition to this that in many cases ontogeny is no absolutely true reflection of phylogeny, and that, especially the older an animal form (as in this case the sponges undoubtedly are), the more may the phylogenetic recapitulation in the individual development be effaced. I might also say that every true *Olynthus*, like a simple gastrula, is, as an ovate, cylindrical, or conical body, radiate, for through its polar axis we may draw an infinity of longitudinal planes, every one of which will divide it into two exactly similar halves; this, however, I will not do, seeing that although it is incontrovertibly true, it would sound something like an evasion. But this much is certain—the radial canals and their arrangement are not the exclusive, and perhaps not even the oldest, criterion, of a radiate structure in the Cœlenterata.

If, however, we look somewhat more closely into the processes of development, as shown, for example, in the admirable pictorial representations that Schulze* has given us of the ontogenetic processes in *Sycon raphanus*, it will not be difficult to recognize a true radiate structure in certain stages. I shall lay less stress upon the free-swimming larva with its girdle-ring of granular cells (Taf. xviii. figs. 3–5), although even in it a radiate structure is already expressed; but let the reader examine especially fig. 12 on Taf. xix., which represents a young *Olynthus* as seen from above. We look down upon the flattened oval extremity of a hollow cylinder, which is perforated excentrically by a round aperture leading

* Zeitschr. f. wiss. Zool. Bd. xxxi. Taf. xviii. & xix.

into the gastral space, and "*at the periphery of the obliquely truncated oscular area there appear symmetrically arranged quadriradiates*" (*loc. cit.* p. 288), and, indeed, six in number; the three rays which lie in the same plane are so placed that the two continuous ones, which constitute a curved axis, embrace the margin of the disk peripherally, while the unpaired one passes perpendicular to them centripetally and radially into the disk itself, and thus this oscular area is divided up into six regularly radiately arranged parts (antimeres). But if we remember what were the causes of the radiate structure it becomes clear that it is a matter of perfect indifference what parts of the animal-body may first show it; like bilateral symmetry it may manifest itself in any parts which are not situated in the central axis, and in this case one is as important as another. If the gastræa-theory be true, if of all the systems of organs, so soon as a further division of the animal-body occurred, the digestive cavity first developed, it is by no means logical to assume that the radiate structure would also have affected *it* first of all; perhaps quite the contrary may have been the case, for the gastral cavity was, in the first place, the central and axially situated organ *par excellence*, and it is much more probable that the displacements and radiate arrangements of the parts in the interest of the maintenance of the equilibrium of a swimming animal will have first of all made their appearance in the parietal parts situated around the stomachal cavity. And what does the developmental history of the recent Cœlenterata teach us? That it is of no consequence at all whether the radial arrangement of the cœlenteric apparatus is brought about by centrifugal diverticula from the gastral space, or by partition-like centripetally growing processes from the wall.

In my opinion the characters of the gastro-vascular apparatus furnish a still stronger proof of the Cœlenterate nature of the Sponges than the radiate structure, which only occurs occasionally, although certainly more frequently than people seem inclined to believe. The radiate structure may become effaced in consequence of very long-continued sessility, just as well as parasitism can eliminate the bilateral symmetry of animals; and if sessility is capable of completely suppressing an organ so unmistakably important as a gastral cavity, it is not easy to see why the radiate structure, which is of far less importance to *adherent* animals, should be preserved under all circumstances, or even with special frequency. But the other Cœlenterate character, the ramification of the gastral cavity in the developed animal in the form of centrifugally running canals opening freely outwards, is retained in a true

sponge under all circumstances. How long these canals may be, whether they perforate the thin wall of an *Olynthus* as simple apertures, or in other forms traverse the thick body-wall as a system of profusely branched and frequently anastomosing passages, is quite irrelevant, and depends solely upon the degree of development of the mesoderm. It might perhaps still be objected that the canal-system of the Sponges is developed in such different ways that it certainly cannot always take its origin from the primitive gastral cavity, but at least as often be formed by gaps which make their appearance in the mesoderm, and growing on centripetally and centrifugally, perforate the gastral and dermal surfaces of the sponge-wall only in the second line. But we must not overlook one thing: how is the gastrula of the sponge formed? In perfectly analogous ways: some by invagination, and with this process the formation of the gastral canals from the stomach outwards may be compared; the others by the appearance first of all of a cavity in the cœnoblastema and its subsequent breaking through outwards; and this may be placed side by side with the origination of the canal-system from gaps occurring in the mesoderm. I believe that the former process, as well as the formation of the gastrula by invagination, is the older and more typical, and that the second must be accounted for by some phenomena of adaptation *sui generis*.

In conclusion, I must again assert that it seems to me, so far as the conditions are at present before us, that the arguments which have been urged against the Cœlenterate nature of the Sponges are far from counterbalancing those which are in favour of it.

XII.—*On some Points in the Morphology of the Echinoderms, and more especially of the Crinoids.* By P. Herbert Carpenter, D.Sc., F.R.S., Assistant Master at Eton College.

In a recent number of the 'Revue Scientifique'*, Professor Edmond Perrier has published a short and semipopular article, the title of which appears in the table of contents as "Les Encrines Vivantes, d'après les Explorations du *Challenger*." The author's treatment of his subject, however, is not altogether in accordance with the expectations to which such a title gives rise; for his article is headed simply "Les encrines vivantes," and of the six columns to which it

* Revue Scientifique, tome 35, No. 22, 30 Mai, 1885, pp. 690-693.

extends, not more than half of one and one third of another are concerned with a notice of the Report * on the Stalked Crinoids dredged by the 'Challenger' and the 'Blake.' The remainder of the article is almost entirely devoted to (1) an exposition of the views which Prof. Perrier holds respecting the circulatory apparatus of the Echinoderms in general and of the Crinoids in particular; (2) a new primary classification of the Metazoa; (3) a list of the genera of recent "Encrines"; and (4) a list of the species in the Paris Museum of Natural History.

I propose to say a few words upon each of these heads, with the exception of the second, to which I would direct the attention of those zoologists who are interested in questions of general classification.

Prof. Perrier regrets that with the material at my disposal I did not enter more fully into "une histoire anatomique des Encrines vivantes" †. At the commencement of chapter vi. of the 'Challenger' Report, which contains 42 pages devoted to the minute anatomy of the disc and arms, I stated expressly that I did not propose to devote so much attention to this subject as I had done to the comparative morphology of the Crinoid skeleton; for I had been "able to confirm, in almost every respect, the admirable investigations of Ludwig ‡ on the minute anatomy of *Antedon rosacea*." It did not appear to me to be necessary to go into the whole question again from the beginning, and I therefore limited myself to a general account of the anatomy of the soft parts as far as I have been able to work it out in six genera of Stalked Crinoids and in three *Comatulæ*. In addition to this, I entered into a considerable amount of anatomical detail when discussing the generic affinities of *Rhizocrinus* and *Bathycrinus*. But, unfortunately, Professor Perrier tells us that many of Ludwig's results, and therefore, by implication, of mine too, are erroneous. This is doubtless only too true, and I am anxiously awaiting Prof. Perrier's promised demonstration of the fact.

Owing to the circumstances of the case, the material at my disposal had not been specially prepared for minute anatomical work, having been in spirit for many years without any previous hardening; while, on the other hand, Prof. Perrier's observations have been carried out on a constant supply of fresh material with all the advantages of an elaborate

* Zool. Chall. Exp. part xxxii.

† *Loc. cit.* p. 693.

‡ "Beiträge zur Anatomie der Crinoideen," Zeitschr. f. wiss. Zool. 1877, Band xxviii. pp. 255–353, Taf. xii.–xix.

technique. Under these circumstances he has certainly seen much which had escaped my notice. But this scarcely justifies him in saying "Toute la physiologie des crinoïdes demeure donc, après le travail du naturaliste du *Challenger*, dans l'obscurité où il l'avait trouvée" *. I freely admit that I have not yet risen to the conception that the water which enters the body-cavity of a Crinoid by the ciliated funnels of the disc is expelled by powerful muscles through pores at the syzygies of the skeleton; nor that the blood- and water-vessels of a Crinoid, together with the body-cavity and its radiating extensions, constitute a vast system of intercommunicating canals with "le même rôle physiologique que l'ensemble des cavités creusées dans le corps des polypes et des éponges" †.

It is difficult to study pure physiology upon spirit specimens, and it is unfortunately true that I have been unable to add much to Ludwig's account of the circulatory apparatus; but, all the same, I venture to think that I have made some additions to our knowledge of the physiological anatomy of the Crinoids. I speak under correction; but it is certainly my impression that the Report on the 'Challenger' Crinoids, together with my previous writings upon the subject, contains the first descriptions and figures of the following points of physiological anatomy:—

1. The trifascial articulation between certain joints of the rays and arms of *Bathycrinus*, and the entire absence of syzygies in this genus.
2. The complex coiling of the alimentary canal in *Actinometra*, and the accompanying variation in the structure of its ovoid gland, to use Perrier's own expression.
3. The presence at the sides of the ambulacra, both of disc and arms, of radiating branches from the axial nerves of the skeleton; and the extension of fibres from this network into the spinelets on the disc of *Pentacrinus*.
4. The ramification within the stem-segments of fibres from their central nervous axis.
5. The absence of any ambulacral grooves and of their associated organs on the arms and disc in many specimens of *Actinometra*, and on the completely plated genital pinnules of some species of *Antedon*.
6. The presence of well-developed ovaries in the disc of individuals of two species of *Antedon* and one of *Actinometra* ‡.

* *Loc. cit.* p. 693. † *Ibid.* p. 692.

‡ Professor Perrier intimates that I differ from my father with respect to that portion of the genital glands which lies within the disc of a

The above list might be considerably extended. I trust, however, that it is long enough to show that the Crinoid collections made by the 'Challenger' and 'Blake' have not been so completely barren of additions to our physiological knowledge as Professor Perrier asserts.

But the absence of physiological results has not been my only sin of omission. According to Professor Perrier, I ought to have worked out in detail the embryogeny of the common *Antedon rosaceus* of the British seas, for the purpose of throwing light upon the anatomy of the adult Crinoid; and he says that I might have obtained the necessary materials at Eton, since he procured them at Paris *. Has he forgotten the note † which I sent him last year "On some Points in the Anatomy of larval Comatulæ"? I stated in this note that I had continually felt the want of some knowledge of the organogeny of the Crinoid type, and had therefore procured larvæ of various stages from Naples and Torquay, which had enabled me to check some of the results obtained from an investigation of the adult anatomy. But as I was not professing to write an exhaustive monograph of the Crinoidea, I did not conceive it to be part of my duty to work out a detailed account of the embryogeny of a type which is accessible to every European naturalist. An already lengthy report would have been swelled to gigantic dimensions. The number of plates required would have increased from 69 (not 61, as quoted by Perrier) to over 100, for Prof. Perrier tells us that his own memoir on this subject is still incomplete, and that thirty plates are already drawn. If the various naturalists who have undertaken to report upon the different groups of animals collected by the 'Challenger' were expected to give a complete anatomical and physiological description of each group, and to supplement it by a detailed account of the embryogeny of its representative in European seas, the publication of their reports would be delayed indefinitely; and yet

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Crinoid. I can only say that I cannot understand how this impression can have occurred to any one who has taken the trouble to read pp. 108 and 109 of the 'Challenger' Report.

* I would here express my sense of the courteous kindness of Prof. H. de Lacaze-Duthiers, who offered to place at my disposal all the resources of his laboratory at Roscoff, during June and July of this year, for the purpose of working out the embryogeny of *Antedon rosaceus* by the most approved modern methods. I would have given much to have been free to accept this invitation; but my professional duties kept me in England during both the months named, and, for the present at least, I must leave the verification of Prof. Perrier's results to other hands.

† Quart. Journ. Micr. Sci. N.S. vol. xxiv. pp. 319-327 (April 1884).

this appears to be the standard set up by Professor Perrier for those who have large zoological collections committed to their charge for examination and description within a limited time.

Under these circumstances, therefore, one might expect that the Report by Professor Perrier* upon the fifty-four species of Asterids which were obtained by the 'Blake' in the Caribbean Sea, a collection second only in importance to that made by the 'Challenger,' would be a model of its kind.

In the absence both of an index and of a table of contents, one has some difficulty in making out what is contained in this memoir of 1.0 pages. Of the ten plates which accompany it, only one is devoted to any other part of the subject than the external appearance of the new species established by Prof. Perrier. At the foot of this plate, which is almost entirely occupied by figures of pedicellariæ and spines, there is the extraordinary legend "Organisation des *Hymens discus*"; and the reader has to turn back to the explanation of the plates in order to learn that the name of Prof. Perrier's new genus is in reality *Hymenodiscus*. Not one of the remaining nine plates contains any figures illustrating the organogeny of the starfish, a subject upon which we are still much in want of information, despite the admirable researches of Ludwig † upon *Asterina gibbosa*. Neither is there any section of the text devoted to this question, while the amount of physiological and anatomical information which the report contains is meagre in the extreme.

Three years ago Professor Perrier published a short note ‡ in the 'Comptes Rendus' to call in question the correctness of some of Ludwig's observations on Asterid morphology; and many Echinoderm students had hoped that he would take the opportunity afforded by the material of the 'Blake' Starfishes to substantiate his charges respecting the accuracy of Ludwig's work on the group. But the whole question is completely ignored, with the exception of one or two references to the position of the stone-canal, and there is not a word about the organogeny of the Starfish type, a subject which, according to

* "Mémoire sur les Etoiles de Mer recueillies dans la Mer des Antilles et le Golfe du Mexique durant les Expeditions de dragage faites sous la direction de M. Alexandre Agassiz," Nouvelles Archives du Muséum d'Histoire Naturelle, 2e série, tome vi. 1884, pp. 127–276, pls. 1–10 (1884).

† "Entwicklungsgeschichte der *Asterina gibbosa*, Forbes," Zeitschr. f. wiss. Zool. Bd. xxxvii. 1882, pp. 1–98, Taf. i.–viii.

‡ Perrier and Poirier, "Sur l'Appareil circulatoire des Etoiles de Mer," Comptes Rendus, t. xciv. 1882, pp. 658–660.

Prof. Perrier's standard for other reports, should have been worked out in full detail.

His own report commences with a section upon the primary divisions of the class of Stellerids, the keynote of which is struck in the following sentence *:—"On peut dire d'une manière générale que *toutes les Etoiles de mer à tubes ambulacraires bisériés, ont une bouche ambulacraire, et que toutes les Etoiles de mer à tubes ambulacraires quadrisériés, au moins à la base des bras, ont une bouche ambulacraire.*"

The unfortunate zoologist who is not a Starfish specialist, but merely wishes to learn the general systematic results which have been arrived at by the most eminent living writer on the group, will rise from the perusal of this sentence with an even more confused notion of the classification of the Asterids than he had before. For, according to Viguier †, the biserial ambulacra are usually, but not always, correlated with an adambulacral mouth, and not with an ambulacral one as Professor Perrier tells us.

Two pages further on he commences another section which is devoted to the morphological signification of the pedicellariæ in Asterids and Urchins and to their physiological rôle. But no reference whatever is made to the elaborate observations of Romanes and Ewart ‡ upon the functions of the pedicellariæ; and the discovery of glands upon the gemmiform pedicellariæ of Echini is attributed to Geddes and Beddard, although these authors themselves admit § that their "account of the structure of these pedicellariæ substantially bears out what has been said" by Sladen ||. But although Mr. Sladen's paper was published in 1880 it is completely ignored by Prof. Perrier four years later; and Foettinger's memoir ¶ on the same subject is also left entirely without notice. The same neglect of the writings of the English naturalist who is engaged in working out the 'Challenger'

* *Op. cit.* p. 138.

† "Anatomie comparée du squelette des Stellérides," Arch. de Zool. expér. et gén. t. vii. Année 1878, p. 82.

‡ "Observations on the Locomotor System of Echinodermata," Phil. Trans. 1881, pp. 840–852.

§ "On the Histology of the Pedicellariæ, and the Muscles of *Echinus sphæra*," Trans. Roy. Soc. Ed. vol. xx. 1881, p. 392.

|| "On a remarkable Form of Pedicellaria and the Functions performed thereby; together with General Observations on the Allied Forms of this Organ in the Echinidæ," Ann. & Mag. Nat. Hist. ser. 5, vol. vi. Aug. 1880, pp. 101–114, pls. xii., xiii.

¶ "Sur la Structure des Pédicellaires gemmiformes de *Sphærechinus granularis* et d'autres Échinides," Arch. de Biol. vol. ii. pp. 455–496, pls. xxvi.–xxviii.

Starfishes appears in the systematic portion of Prof. Perrier's report.

In the year 1882, Sladen published an account of the structural peculiarities presented by the Pterasteridæ, and pointed out their systematic value *; but although Prof. Perrier enters into some detail respecting the structure of *Pteraster caribbæus*, he completely ignores all that had been written upon the subject two years previously.

In fact, throughout the whole of Prof. Perrier's report the work of German and English writers upon the morphology of the Asterids, and their relation to the Echinodermata generally, is left entirely unnoticed. The observations of Geddes and Beddard were made in a French laboratory and are therefore mentioned; but no reference is given to the place of their publication; while the papers of Ludwig, Sladen, and myself might never have been written so far as Prof. Perrier is concerned. This neglect of the results of fellow workers who do not happen to be Frenchmen may be patriotic, but it is neither wise nor scientific; and in one case, as has been already explained in this journal †, Prof. Perrier's omission to consult any one of some four papers by Pourtalès and myself which contain descriptions of the calyx of *Rhizocrinus* has led to zoological science being enriched with a new synonym. For Prof. Perrier has at last come to the conclusion, as he would have done at first had he taken the trouble to make himself acquainted with the literature of his subject, that his genus *Democrinus* is identical with *Rhizocrinus* ‡.

It was pointed out by Pourtalès in 1868 §, and again in 1874 ||, that *Rhizocrinus* has large and well-developed basal plates like those of *Bourgueticrinus*; and in his second paper he corrected the mistake which had been made by Sars ¶ in describing the basals of *Rhizocrinus* as internal and concealed. These results were confirmed by myself in 1877 **, and again

* "The Asteroidea of H.M.S. 'Challenger' Expedition.—Part I. Pterasteridæ," Journ. Linn. Soc., Zool. vol. xvi. pp. 190, 191.

† "Note on *Democrinus Parfaiti*," Ann. & Mag. Nat. Hist. ser. 5, vol. xi. pp. 334–336.

‡ Revue Scientifique, 30 May, 1885, p. 691, note.

§ "Contributions to the Fauna of the Gulf Stream at Great Depths," Bull. Mus. Comp. Zoöl. vol. i. no. 7, pp. 128–130.

|| "Zoological Results of the 'Hassler' Expedition," Ill. Cat. Mus. Comp. Zoöl. no. viii. pp. 28, 29.

¶ 'Mémoires pour servir à la connaissance des Crinoïdes vivants,' Christiania, 1868, p. 12.

** "On some Points in the Anatomy of *Pentacrinus* and *Rhizocrinus*," Journ. Anat. & Physiol. vol. xii. 1877, p. 50.

in 1882 *. I know that Prof. Perrier received copies of both papers. In fact he quoted a portion of the second one (without acknowledgment) in his brief notice of *Democrinus* in the 'Comptes Rendus' †. Nevertheless he stated in this description that the basals of *Rhizocrinus* are "confondues," while those of *Democrinus* are large and well developed, this being the very character of *Rhizocrinus* which had been pointed out four times by Pourtalès and myself during the previous thirteen years.

A similar neglect of the work of other naturalists appears in that section of the report on the 'Blake' Starfishes which is devoted to the morphological signification of the odontophore. Page 159 of this section is disfigured by two serious errors. In one place we are told that "les pièces radiales" of the young Starfish become the odontophores of the adult; and, as if to impress the characteristic symmetry of the Echinoderm type still more forcibly upon the mind of the reader, the author continues "L'une de ces pièces radiales ne tarde pas à présenter les sillons caractéristiques de la plaque madreporique."

Much has been written by Ludwig ‡ about the morphology of the odontophore in the Asterids; but his name, like that of Sladen, is conspicuous by the absence of any reference to it in the memoir of Prof. Perrier. In fact, Ludwig's theory that the periproct of an urchin is represented, not by the calyx but by the ventral side of a Crinoid §, is put forward as a novelty by Prof. Perrier ||, who is apparently unaware that it was published by Ludwig so long ago as 1880, and that the morphological difficulties which it involves were pointed out by myself in the same year ¶. Even in those cases when Prof. Perrier is compelled to take account of the work of another author, he is often unable to quote correctly, and the results are sometimes remarkably confusing. After reproducing (with-

* "The Stalked Crinoids of the Caribbean Sea," Bull. Mus. Comp. Zoöl. vol. x. no. 4, 1882, p. 174.

† "Sur un nouveau Crinoïde fixé, le *Democrinus Parfaiti*, provenant des dragages du 'Travailleur,'" Comptes Rendus, tome xcvi. no. 7, pp. 450, 451.

‡ 'Morphologische Studien an Echinodermen,' Bd. i. Leipzig, 1877, pp. 228–234, 254–269; and also "Das Mundskelet der Asterien und Ophiuren," Zeitschr. f. wiss. Zool. Bd. xxxii. 1879, pp. 672–688.

§ *Ibid.* p. 688; and also "Ueber den primären Steinkanal der Crinoideen nebst vergleichend-anatomischen Bemerkungen über die Echinodermen überhaupt," *ibid.* Bd. xxxix. 1880, pp. 317–319.

|| *Op. cit.* p. 161.

¶ "Some disputed Points in Echinoderm Morphology," Quart. Journ. Microsc. Sci. vol. xx. new ser. pp. 322–329.

out acknowledgment) the list of families and genera of the living Stalked Crinoids described in the 'Challenger' Report, he adds*, "Outre ces six genres, deux autres genres d'Encrines ont été décrits, le genre *Ilyocrinus* par Koren et Daniellsen (*sic*), et le genre *Democrinus* par moi. Les auteurs scandinaves s'accordent à penser que leur *Ilyocrinus* n'est qu'un *Bathycrinus alarchianus* mieux développé que le type. Je trouve cependant dans les collections du 'Talisman' un crinoïde d'assez grande taille, chez qui il existe cinq basales non soudées, presque aussi grande que les radiales; si cet exemplaire unique n'est pas une monstruosité, c'est un *Ilyocrinus* qu'on pourrait appeler *Ilyocrinus recuperatus*."

This paragraph contains two serious (clerical?) errors. The name of Danielssen and Koren's genus is *Ilycrinus*†, not *Ilyocrinus*; and *Bathycrinus Aldrichianus* would be more correct than *Bathycrinus alarchianus*. It may be that Prof. Perrier has had some private communication with the Scandinavian authors upon the subject; but I have no knowledge of their having published any such views as he attributes to them. According to him they regard *Ilycrinus* (*Carpenteri*) as a *Bathycrinus Aldrichianus* better developed than the type. The type of what? of *Bathycrinus Aldrichianus*? This can hardly be the case, for the two species are very nearly the same in size, the 'Challenger' form from the southern seas being, if anything, slightly larger than *Bathycrinus Carpenteri* (*Ilycrinus*) from the North Atlantic.

Prof. Perrier's statement reads like a paraphrase of what I wrote respecting *Bathycrinus* and *Ilycrinus* in 1882. The former genus was founded upon an immature specimen dredged by the 'Porcupine,' which Sir Wyville Thomson named *Bathycrinus gracilis*‡; and I pointed out§ that "his description|| of the larger species, *B. Aldrichianus*, from the southern sea, seems not to have reached the Norwegian naturalists before the publication of their genus *Ilycrinus*, which was founded on much more developed individuals than that dredged by the 'Porcupine.'" This *B. gracilis* appears to be the poorly developed type which is referred to by Prof. Perrier in this exposition of the views of Danielssen and Koren, who have not, so far as I am aware, ever made any such

* 'Revue Scientifique,' May 30, 1885, p. 691, note.

† "Fra den Norske Nordhavsexpedition Echinodermer," Nyt Mag. f. Naturvid. Bd. xxiii. 1877, p. 45.

‡ "On the Crinoids of the 'Porcupine' Deep-sea Dredging Expedition," Proc. Roy. Soc. Edinb. vol. vii. 1869–72, p. 772.

§ Bull. Mus. Comp. Zoöl. vol. x. no. 4, p. 177.

|| "Notice of new Living Crinoids belonging to the Apiocrinidæ," Journ. Linn. Soc., Zool. vol. xiii. 1876, pp. 48–51.

comparison between their *Ilycrinus* and *Bathycrinus Aldrichianus* as is attributed to them by Prof. Perrier.

He further mentions a remarkable specimen with five basals which are not united, and are almost as large as the radials. It cannot be *Ilycrinus* (D. & K.), which has quite small and very closely united basals; but if it is not a monstrosity, I am quite prepared to accept it as a new genus, *Ilyocrinus*, Perrier, with the specific name *recuperatus*. I must protest, however, against its appearing on the same page of Perrier's article among the list of Crinoids in the Paris Museum as *Hyocrinus recuperatus*. This is especially confusing, as there is already a well-known genus *Hyocrinus*, which was established by Sir Wyville Thomson in 1876.

According to Prof. Perrier's list, the Paris Museum also contains an undescribed species of *Pentacrinus*, viz. *P. asterius*, Miller; or is it possible that this is the original *Pentacrinus* which was described by Guettard, and was named *Isis asteria* by Linnæus, *Pentacrinus caput-medusæ* by Miller, and has been finally described as *Pentacrinus asterius*, Linn., sp.?

Another instance of the superficial manner in which Prof. Perrier has examined the work which he is supposed to be criticizing is afforded by the first line of the following statement*:—"Les *Pentacrinus* et *Metacrinus* ne diffèrent d'ailleurs que par le nombre des pièces calcaires (*pièces radiales*) qui se disposent en file pour soutenir les cinq premières paires de bras, et peut-être n'y avait il pas nécessité absolue de créer pour cela deux noms de genres distincts." The genus *Metacrinus* was suggested by Sir Wyville Thomson; but no other generic name has been established, as hinted by Prof. Perrier, on account of the difference of this type from that of *Pentacrinus* proper, which dates back to the time of Miller, as Prof. Perrier knows. It is true that in my preliminary report upon the 'Blake' Crinoids † I mentioned the number of radials as a difference between *Metacrinus* and *Pentacrinus*, because it is the character by which the two types can be distinguished at a glance; but I likewise stated that the radials of *Metacrinus* bear pinnules, which is not the case in *Pentacrinus*. If Prof. Perrier will take the trouble to refer to pp. 339 and 340 of the 'Challenger' Report he will find that the two genera also differ in the characters of the stem, cirri, arms, basals, and disc. Nevertheless, with this statement and the figures illustrating it before him, he tells us that the only difference

* 'Revue Scientifique,' May 30, 1885, p. 691.
† Bull. Mus. Comp. Zoöl. vol. x. no. 4, p. 167.

between the two types is in the number of their radials. What would he think of the reviewer of his Report on the 'Blake' Starfishes who said that the only difference between his two genera *Hymenodiscus* and *Anthenoïdes* was that the latter had but five arms and the former twelve?

Prof. Perrier's investigations into the obscure and much-neglected subject of the physiology of the Crinoids have led him to attribute a hitherto unsuspected function to the syzygial unions which occur in certain portions of the skeleton. He tells us*:—"Il y a au niveau de ces sortes d'articulations immobiles qu'on appelle les syzygies, chez les Encrines, tout un système de cavités puissamment munies des muscles qui chassent évidemment l'eau dans la substance même du tissu imprégné de calcaire des bras ou la conduisent au dehors et l'expulsent par les trous qui sont répartis à égale distance sur le pourtour de la syzygie."

It is, I think, much to be regretted that Prof. Perrier should have departed so far from the nomenclature of Müller and his successors as to speak of a syzygy as a kind of immovable articulation. Müller† called it an "unbewegliche Nathverbindung;" and he distinguished between a "Nath" and a "Gelenk" in the anatomy of a Crinoid. He only used the latter term when the two articulated joints were capable of movement upon one another; and this distinction has been almost universally adopted by later writers upon the subject, so that the term "articulation immobile," which Prof. Perrier employs has a somewhat contradictory sound. In the next line we are told by Prof. Perrier that among the "Encrines," the term which he uses throughout the whole of this article for the Stalked Crinoids only, the two joints are separated by a system of cavities which open externally by a series of pores round the edge of the syzygy. Such being Prof. Perrier's statement, let us examine in detail the evidence upon which it is based. In the first place, as explained in the 'Challenger' Report ‡, there are no syzygies at all anywhere in the arms of *Bathycrinus*. The Crinoids of this type are consequently very far from possessing such an extensive communication between the internal cavity and the exterior as is supposed by Prof. Perrier's theory that they are really in the same physiological condition as the sponges. For the number of ciliated water-pores on the disc of *Bathycrinus* is extremely limited and by no means a "foule d'orifices;"

* 'Revue Scientifique,' May 30, 1885, p. 692, note.

† "Ueber den Bau des *Pentacrinus caput-medusæ*," Abhandl. d. k. Akad. d. Wiss. Berlin, 1843, p. 39 (of separate copy).

‡ Zool. Chall. Exp. part xxxii. pp. 9, 231–233.

while in the case of *Rhizocrinus* one has still more difficulty in accepting Prof. Perrier's theory. For there are only five water-pores, at any rate in *R. lofotensis*; and though there are sygygies on the arms, their outlines are not marked by anything like pores, as is the case in the *Comatulæ*. As Prof. Perrier has plenty of *Rhizocrinus*-material at his command it is a little surprising that he should have committed himself to a general statement of this kind, which is so far from being in accordance with the actual facts of the case. The absence of the striæ, which are so characteristic of the syzygial faces of the *Comatulæ*, on the corresponding faces of the arm-joints of *Rhizocrinus* was noted by Sars *; and without striæ there can be no pores. This observation was confirmed in the 'Challenger' Report; and it was also pointed out that the closeness of the syzygial union is increased by there being a small pit in the hypozygal which receives a backward process on the lower surface of the epizygal†. It will puzzle Prof. Perrier to discover, even with what his colleague Mons. Koehler calls "the eye of faith," any appearance of pores round the outline of a syzygial union in *Rhizocrinus*. The condition of the two living genera of the Bourgueticrinidæ, therefore, is far from being such as is implied by Prof. Perrier's very general statement; and he will find some difficulty in reconciling it with his "simple and new" conception of the mode of nutrition of the Crinoids. Let us see how far his statement is applicable to other genera of "Encrines" or Stalked Crinoids. He has never seen the arms of *Hyocrinus*, but apparently takes for granted the presence of syzygial pores, such as he believes to exist in the *Comatulæ*. I have not been able to examine one of the syzygial faces in an arm-joint of this genus, but there is no external indication of the presence of any radiating markings such as occur in the *Comatulæ*. The lines of syzygial union are perfectly continuous and uninterrupted, as is well shown in the figures published by Sir Wyville Thomson in 1876 ‡ and reproduced in pl. vi. of the 'Challenger' Report.

Here, then, is a third "Encrine" to which Prof. Perrier's statement and theory do not apply; and he fares no better in the case of *Holopus*. If there are any syzygial unions in the skeleton of this type at all they only occur between the two outer radials, and it is extremely doubtful if such is the case. At any rate, however, the apparent lines of syzygial union have no indication of possible pores, as is the case in the

* 'Crinoïdes vivants,' p. 22.

† Zool. Chall. Exp. part xxxii. pp. 5, 254, pl. x. figs. 1, 6, 8, 17–19.

‡ Journ. Linn. Soc., Zool. vol. xvi. pp. 51, 52.

Comatulæ. Thus, then, the only two recent "Encrines" to which Prof. Perrier's very general statement is at all applicable are *Pentacrinus* and *Metacrinus.* These two genera have syzygial unions in the stem as well as in the arms; but the apposed syzygial faces at one of the nodes of the stem are as smooth as they can be, and altogether devoid of any such markings or sculpture as could give rise to the appearance of pores along their line of union*. The syzygial unions in the rays and arms, however, are sometimes of a slightly different character and present some approach to the condition of the syzygies in the arms of *Comatulæ.* Dr. Carpenter † has described how each syzygial face in the arm of *Antedon rosaceus* is "almost flat, except that it presents a series of slightly elevated ridges with alternating furrows, which radiate from the opening of the central canal towards the dorsal margin. . . . The two sets of ridges are applied to each other, leaving between them flattened passages that are formed by the correspondence of the furrows. . . . . An examination of decalcified specimens shows that the canals are occupied by radial extensions of the ordinary sarcodic basis-substance. The peculiar arrangement of these suggests that, like the 'medullary rays' of an exogenous stem, they may serve to establish a communication between the 'medullary axis' of this basis-substance which occupies the central canal, and the 'cortical envelope' by which the surface of the segment is invested." The cœliac canal rests in a more or less defined furrow upon the upper or ventral surface of each arm-joint, the so-called ambulacral groove of the skeleton; and Prof. Perrier tells us ‡ that "au niveau des syzygies, la cavité cœliaque communique avec un système de cavités rayonnant autour du cordon nerveux, entourées de muscles et qui jouent évidemment un rôle important dans la nutrition de la partie solide des bras."

This statement contains much debatable matter. In the first place, one would certainly expect that the contents of these syzygial cavities would be in communication with the axial canal from which they radiate, rather than with the cœliac canal on the ventral surface of the joint; but in a very large number of *Comatulæ* belonging to the genera *Antedon*, *Actinometra*, and *Promachocrinus* the axial canal or radial

* Zool. Chall. Exp. part xxxii. pp. 4, 5, 13, pls. xxxi., xxxii., xxxvii., xlvii., &c.

† "Researches on the Structure, Physiology, and Development of *Antedon* (*Comatula*, Lamk.) *rosaceus.*—Part I.," Phil. Trans. 1866, pp. 720, 721.

‡ "Résumé de Recherches sur l'organogenie des *Comatules*," Zool. Anzeiger, viii. Jahrg. 1885, no. 194, p. 265.

centre of the syzygial cavities is separated from the cœliac canal, which Prof. Perrier regards as their functional centre of supply, by more than half the height of the arm-joint. This is not the case in *Antedon rosaceus*, the type chiefly studied by Prof. Perrier; for it has relatively low arm-joints with a deep ambulacral groove on their ventral surface, so that there is but a thin layer of limestone between the bottom of the cœliac canal and the axial canal from which the syzygial cavities radiate. But if Prof. Perrier had had a more extensive acquaintance with the different types of arm-joint which occur in the *Comatulæ* and with the variations in the sculpture on their syzygial faces, I cannot but think that he would have hesitated before making the statement which has been quoted above.

It will be seen that he agrees with Dr. Carpenter in regarding these radiating syzygial furrows as nutritive in function, though he believes them to be filled with water from the cœliac canal, rather than with the sarcodic basis-substance of the skeleton, which would maintain communication between the internal and external tissues of the arm-joint, the latter often reaching a considerable thickness. The origin of these radiating canals in the central canal of the arm-joints which lodges the neuro-vascular axial cord certainly agrees better with the latter theory than with that of Prof. Perrier. It may be noted, too, that in his first account* of these cavities in the *Comatulæ*, he said not a word about their communicating with the exterior, as they sometimes seem to do in a dried arm of *Comatula*, or in a fragment which has been boiled in potash. He now tells us, however, that in the Stalked Crinoids (Encrines) these radiating cavities are not only present at the syzygies, but that they communicate with the exterior by pores placed at equal distances round the outline of the syzygy. Can he name a single Stalked Crinoid in which the syzygial faces are separated by radiating passages as in the *Comatulæ* and there are pores round the outline of the syzygies? *Bathycrinus* has no syzygies at all; and there are no pores or anything resembling them in *Rhizocrinus*, *Hyocrinus*, or *Holopus*. Prof. Perrier has never seen a *Metacrinus*, or he would scarcely have doubted its distinctness from *Pentacrinus*; and, unless I am greatly mistaken, he has never had an arm-fragment of the former genus from which to cut a section through a syzygial union. The only possible type, therefore, which could have furnished him with the evidence on which he bases his statements respecting the

* Zool. Anzeiger, 1885, p. 265.

Stalked Crinoids is *Pentacrinus* itself. Can he name a single recent species of this genus in which the syzygial faces are marked by elevated ridges and furrows radiating from the central canal as in the *Comatulæ*? In by far the greater number of cases the joints are perfectly plain, without any indications of sculpture at all *; but there is sometimes a slight trace of striation round the margins of apposed syzygial surfaces. Exactly the same thing often occurs on the apposed surfaces of the basals and radials respectively, and on the lateral surfaces of the radials where they are closely united by suture. Sometimes, indeed, there is a faint indication, over part of the syzygial face, of a radial striation which extends inwards towards the central canal but dies away before reaching it, and is not due to the presence of elevated ridges, as in the *Comatulæ*. The best instance of this which I know is on the apposed syzygial faces of the radials of a *Pentacrinus asterius* which were figured by Sir Wyville Thomson in the 'Challenger' Report †; but his figure of the "pourtour de la syzygie" on the dorsal aspect of the ray shows it to be absolutely devoid of all trace of pores, as is really the case. I have seen many other indications of radial striation, both in this and in other species of Pentacrinidæ; but they are merely superficial markings on the joint-faces, and are altogether different from the well-defined radiating ridges on the syzygial faces of a *Comatula* arm-joint, which can be stripped off entire when the syzygy is split open after decalcification. It is, of course, possible that Prof. Perrier may have obtained a section through a syzygy in a *Pentacrinus*-arm with better-defined radiating ridges and intervening furrows than any which I have seen in this genus; but I doubt it. The dredgings of the 'Talisman' yielded several specimens of *Pentacrinus Wyville-Thomsoni*; and if Prof. Perrier has not cut sections through a syzygy of this species, it would have been better for him to have done so before making a general statement respecting the syzygies of Stalked Crinoids which harmonizes so admirably with his previously expressed views. I have several sections through the largest syzygy in this species, viz. that between the second and third radials; and there is absolutely no trace either of the radiating cavities or of the powerful muscles which Prof. Perrier describes in the "Encrines." I can say the same of the arm-syzygies in *Pentacrinus decorus*; and if the smooth appearance of the syzygial faces is any guide, there is not a single recent mem-

* Zool. Chall. Exp. part xxxii. pp. 4, 254, pls. xxvi. & xxxvii.

† Pl. xii. figs. 17, 18, 21.

ber of the Pentacrinidæ, any more than there is of any other family of Stalked Crinoids, with radiating cavities at its syzygies as described by Prof. Perrier. Even as regards the *Comatulæ*, which do have more or less appearance of external pores at their syzygies, I cannot accept Prof. Perrier's assertion as at all consistent with the facts of the case. I do not deny that pores appear at the syzygies on arms which have been boiled in potash, as was figured by Dr. Carpenter in *Antedon rosaceus* *; but there is a layer of perisome † outside the skeleton which is removed by this treatment, so that the pores appear far more distinctly than they do in a dry arm, and still more so than in a fresh or spirit-specimen. This layer of perisome is very well shown in the terminal parts of arms which have been stained with picrocarmine and mounted in dammar; and the syzygial pores are then seen to be covered by it. The sections which I have made in three planes through the arms of many species of *Comatula* have given me every reason to believe that the pores of the skeleton do not open to the exterior through this layer of perisome (which is often much thicker than in *Antedon rosaceus*) as Prof. Perrier's theory requires; while I much doubt whether the so-called powerful muscles are anything more than the closely set fibres which form the organic basis of the elevated radiating ridges on the syzygial faces. It is certainly very remarkable that the positions assigned to these muscles by Prof. Perrier are exactly those where the calcareous tissue is densest, on the syzygial faces of fossil arm-joints. I have explained elsewhere ‡ how the organic basis of the pieces of the skeleton becomes much more close and compact near those surfaces which are in contact with other joints; and I believe this to be preeminently the case at the syzygies, though the apposed faces are not so perfectly united as in the case of the basals and radials, for the syzygial unions are severed with great ease. If Prof. Perrier really does believe that water is driven out from pores at the arm-syzygies of *Antedon rosaceus*, he can prove it in a very simple way. If he will "pith" the creature by removing its chambered organ it will lie still in the water; and the action of the powerful muscles expelling water from the syzygial pores would surely cause such a disturbance in the surrounding medium as would

* Phil. Trans. 1866, pl. xxxvi.

† The "cortical envelope" of Dr. Carpenter.

‡ "On the Genus *Actinometra*, Müll., with a Morphological Account of a new Species from the Philippine Islands," Trans. Linn. Soc. 1879, 2nd ser., Zool. vol. ii. pp. 55–57.

prove his theory incontestably. Has he performed this experiment or any one which would give the same results? Even then, however, his theory does not hold good for the Stalked Crinoids, none of which have any radiating cavities or pores at their syzygies, while these unions are altogether absent in *Bathycrinus*. His assertion that water is expelled from the cœliac canals of the arms through pores on the "pourtour" of the syzygies would thus appear to be a somewhat hasty generalization from the supposed condition of the *Comatulæ*. It is essential, however, to his conception of a Crinoid as a kind of sponge with incurrent and excurrent openings for the circulation of water. The former are provided for by the ciliated water-pores on the disc; but where are the latter in *Holopus*, *Hyocrinus*, *Bathycrinus*, *Rhizocrinus*, and, I will also add, in the Pentacrinidæ?

Professor Perrier's brief notice of the 'Challenger' Report contains the following passage *:—"Poussé par on ne sait quelle prévention assez mal dissimulée contre ce qu'il appelle un peu dédaigneusement 'l'école française,' M. Herbert Carpenter, dont les études ont été terminées à l'Université de Würtzbourg (*sic*), s'est, en bon camarade, jeté tête baissée à la suite du zoologiste allemand qui a le plus habilement étudié les Crinoïdes. Il affirme en avoir confirmé presque tous les résultats dont beaucoup sont cependant erronés, et il ne se sépare guère de son guide que pour défendre les opinions, d'ailleurs exactes, de son père relativement au système nerveux."

The last sentence contains a statement which falls very considerably short of the truth. Not only do I disagree with the published views of my old friend Prof. Ludwig respecting the nervous system of Crinoids, but I have given a different account of the basals of *Rhizocrinus* from that which he put forward; and, in common with Mr. Sladen †, I dissent altogether from the theory which he has published concerning the relations of the Crinoid calyx in the Urchins and Starfishes ‡. I differ from him and from other German writers, Studer and Hörnes §, upon this purely theoretical point as

* 'Revue Scientifique,' May 30, 1885, p. 693.

† "On the Homologies of the primary Larval Plates in the Test of Brachiate Echinoderms," Quart. Journ. Micr. Sci. n. s. vol. xxiv. 1884, pp. 35-37.

‡ *Ibid.* vol. xx. 1880, pp. 322-329; and "Notes on Echinoderm Morphology.—No. V. On the Homologies of the Apical System, with some Remarks upon the Blood-vessels," *Ibid.* vol. xxii. 1882, pp. 376-386.

§ "On the Apical System of Ophiurids," *Ibid.* vol. xxiv. 1884, pp. 15-18; and Zool. Chall. Exp. part xxxii. pp. 392-400.

strongly as I do from the French authors, Messrs. Perrier, Koehler, and Apostolidès, respecting the supposed communication with the exterior of the so-called blood-vascular system in Urchins and Ophiurids, through the pore-canals of the madreporite. It is on this last point, which deals with fact and not with theory, that, like Ludwig, I am at variance with what I ventured three years ago to call "the French school." My reasons for the "prévention" referred to by Prof. Perrier are twofold.

In the first place, I do not believe many of their statements of fact to be correct, as I distrust the nature of the evidence upon which these are based; and, secondly, there is far too strong a tendency, especially in the case of Professor Perrier, to make a sweeping generalization upon data which are either altogether inadequate or even absolutely incorrect. An excellent instance of the latter kind is afforded by Prof. Perrier's statement respecting the presence of radiating cavities at the syzygies of the Stalked Crinoids, which I have discussed above.

The greater part of his publications upon the morphology of the Crinoids have been limited to what he himself describes * as "quelques fragments isolés" of his results. Some of his earlier statements have been profoundly modified in later communications, while others have been tacitly withdrawn. Among the latter, for example, is the expression of his conviction that no one will ever find the cœliac canal of a Crinoid †, although he now tells us that it communicates with the exterior through pores at the syzygies of the arms. After having once asserted that the cirrus-stumps of a Pentacrinoid larva alternate with those of the arms ‡, in spite of the evidence to the contrary in the descriptions and figures of Dr. Carpenter § and M. Sars ‖, Prof. Perrier now tells us ¶ that the cirri and the arms are "superposed," a fact that has been known for the last twenty years. Then, again, Prof. Perrier ** claims to have "démontré" that the inter-

* Zool. Anzeiger, 1885, p. 267.

† "Recherches sur l'Anatomie et la Régénération des Bras de la *Comatula rosacea*," Arch. de Zool. Expér. et Génér. t. ii. 1873, pp. 48, 49, 73.

‡ "Sur la développement des *Comatules*," Comptes Rendus, tom. xcviii. 1884, p. 446.

§ Phil. Trans. 1866, pls. xl., xli.

‖ 'Crinoïdes vivants,' tab. v. p. 53.

¶ Zool. Anzeiger, 1885, p. 264.

** "Sur une Astérie des grandes profondeurs de l'Atlantique, pourvue d'un pédoncule dorsal," Comptes Rendus, t. xcv. 1882, p. 1381.

radial abactinal plates of the young *Brisinga* eventually become the odontophores; and upon this supposition he based a generalization concerning the whole of the Asterids. As a matter of fact, however, he was merely repeating a statement made some time previously, but never satisfactorily proved; while its accuracy has since been questioned by Sladen *, who has also proved beyond all doubt that, whatever be the case in *Brisinga*, Prof. Perrier is utterly at fault with regard to the fate of the interradial abactinal plates in other Starfishes.

According to Prof. Perrier, it has been demonstrated by himself, together with Koehler and Apostolidès, that the blood-vascular system of Urchins and Ophiurids communicates directly with the exterior through the madreporite. But I have pointed out elsewhere † that no valid proof of this statement has ever been furnished to morphologists, except an account of the results of injections. I may be peculiar, but I do not believe in the injection method as a means of settling intricate anatomical questions. Sometimes, as Ludwig has shown in the case of Greeff and Hoffmann, it proves, or rather appears to prove, far too much; while in other cases it gives altogether insufficient results. Some years ago, in consequence of unsuccessful injections, Prof. Perrier was led to deny the existence of what is generally known as the blood-vascular ring of *Echinus*, and of a vessel which had been supposed to connect it with the so-called heart or ovoid gland ‡. His friend Mons. Koehler, however, was able to demonstrate the presence of these organs without difficulty; and he confirmed the results of his injections by the section-method §. But neither Koehler, Perrier, nor Apostolidès has figured a single section which shows how the ovoid gland of any Urchin or Ophiurid communicates with the exterior; though their injections have caused them to speak of it as a demonstrated truth about which there can be no doubt whatever ‖. Ludwig's careful sections and dissections of the madreporite of a Starfish, however, have led him to the conclusion, which his

* Quart. Journ. Micr. Sci. n. s. vol. xxiv. pp. 39–41.

† "Notes on Echinoderm Morphology.—No. VI.," *Ibid.* vol. xxiii. pp. 597–609; No. IX. *Ibid.* Supplement, 1885, pp. 13–18 (of separate copy).

‡ "Sur l'Appareil circulatoire des Oursins," Comptes Rendus, Nov. 16, 1874; and "Recherches sur l'Appareil circulatoire des Oursins," Arch. de Zool. Exp. et Gén. t. iv. 1875, p. 613.

§ "Recherches sur les Echinides des Côtes de Provence," Ann. du Mus. d'Hist. Nat. de Marseille, Zoologie, Mém. no. 3. pp. 65–70.

‖ R. Koehler, "Quelques mots sur les relations du système circulatoire chez les Echinides," Zool. Anzeiger, Jahrg. viii. 1885, p. 81.

figures fully bear out, that the pore-canals of the madreporite lead into the water-vascular apparatus only, and have absolutely no connexion with the blood-vascular system *.

These statements have never been contradicted by Professor Perrier, who has nowhere described any such communication between the water-vascular and blood-vascular systems of a Starfish as he believes to exist in Urchins and Crinoids.

But all the same, he places the Starfishes, together with the other Echinoderms, in the same division of the Metazoa as the Polypes and Sponges. The bodies of the animals composing this group, which he calls "Zoophytes," are traversed by a set of irrigating canals †—"Il contient de même, non pas de sang, mais de l'eau qu'il puise incessamment au dehors et se substitue tout à la fois à l'appareil circulatoire et à l'appareil respiratoire des animaux mobiles, à la symétrie bilaterale, avec lesquels il n'a aucun rapport morphologique. On doit remarquer que, chez les échinodermes, il dérive au moins indirectement de la cavité digestive primitive."

This conception of the mode of nutrition of Echinoderms is well described by Prof. Perrier as both "simple and new;" but he can scarcely expect it to be adopted by other naturalists until he can demonstrate to their satisfaction the fundamental unity of the double vascular system and its communication with the exterior not only in Echini, Ophiurids, and Crinoids, but also in Starfishes and Holothurians, about which groups he has given us no positive information at all.

My own observations have led me to believe that the statements which he has permitted himself to make concerning the presence of excurrent openings in the arms of Stalked Crinoids are absolutely without any foundation of anatomical fact. But they harmonize with his theories of Crinoid morphology in a way which leaves nothing to be desired for completeness; and I have a strong suspicion that some of his other assertions respecting the vascular system of the Echinoderms are equally untrustworthy, as, indeed, has been already proved by Koehler. Other investigators are at work upon the subject, and we may hope to hear a good deal about it before many months are past.

* "Beiträge zur Anatomie der Asteriden," Zeitschr. f. wiss. Zool. Bd. xxx. 1878, p. 104.

† 'Revue Scientifique,' May 30, 1885, p. 692.

XIII.—*Description of a new Species of the* Zetides *Section of* Papilio. By F. Moore, F.Z.S., A.L.S.

Zetides Acheron, n. sp.

Nearest to *Z. Axion*. Upper side differs in the medial transverse band being broader, the discoidal spots longer, and the marginal spots larger. Underside: markings more nacreous than in *Z. Axion* or *Z. Telephus*: fore wing with the medial transverse band much broader throughout and very slenderly divided by the veins; discoidal spots all larger, the two terminals well separated, the penultimate upper spot entire: hind wing with a very broad medial band of wider extent than in *Z. Evemon*; the subbasal costal red-banded streak also broad; the black spot at end of the cell linear and narrow, with the red lunule situated outside the cell between the lower subcostal and radial vein; a red lunule (but no preceding black spot) between the radial and upper median; the other two succeeding black spots being quadrate, and their red lunule recurved; the marginal row of spots of a conical shape, their upper end almost touching the red lunules.

Expanse $3\frac{1}{8}$ inches.

Hab. N.E. Bengal. In coll. F. Moore.

XIV.—*A new Frog* (Rana sternosignata) *from Sind.* By James A. Murray, Curator of the Kurrachee Municipal Museum.

In this paper I have to add a Batrachian to the already known forms in Sind.

I am indebted for the specimens to Captain J. Babington Peile of the P. W. own Grenadiers, who very kindly undertook to make a collection of specimens for the Kurrachee Museum, when on the Zhob Valley expedition, and to Mr. J. Strachan, M.I.C.E., of the Kurrachee Municipality. Capt. Peile's specimens are from Zandra in Afghanistan and Quetta, and Mr. Strachan's from Mulleer near Kurrachee.

Rana sternosignata, sp. nov.

Head broad, without an occipital fold. Gape 1·5 inch across. Snout rounded, without *canthus rostralis*, nostrils nearer the eye than the end of the snout. Tympanum rather indistinct, about one third the size of the eye. Interorbital space slightly concave and as wide as the upper eyelid. A plait behind the eye above the tympanum not very distinct in some speci-

mens. Vomerine teeth in two small groups between the inner nostrils. Lower jaw with two not very prominent apophyses. Back and upper surface of hind limbs finely tubercular. Sides rugose, with spiniferous warts. *On the under surface there are two nearly circular patches of minute dark spinescent tubercles on the sternum, and the abdomen is covered with large horny-tipped tubercles, while under the throat and, in some specimens, on the chin also there are patches of minute spinous granulations.* Fore limb short and stout; fingers of moderate length, the tips dilated into small disks; subarticular tubercles well developed. Palmar surface of both fore and hind feet with minute, scattered, conical, dark spinous tubercles. Laid side by side the second and fourth fingers are equal, the first smallest and the third longest. *First finger with a nodose prominence covered with minute tubercles on the dorsal surface; second finger the same, with the nodose prominence less developed, while below, on the side of the first finger, is also a thumb-like prominence covered with tubercles.* Hind limbs moderate. The distance between vent and knee equals half the length of the head and body. Laid forward, the knee reaches the axil of the fore limb and the metatarsal tubercles the tip of the snout. The toes are webbed to the base of the disks or swollen tips, and bear subarticular tubercles; metatarsus with a single elongate spur-like tubercle. A cutaneous fringe along the margin of the first and fifth toes.

Colours. From olive-brown to dark brown on the dorsal surface; yellowish brown on the ventral surface, with or without, or with a very few dark brown specklings. Chin and throat yellowish white, more or less marbled with brown. Inner side of thighs brownish, with flocculent yellowish marbling.

Locality. Mulleer near Kurrachee; Zandra and Quetta, in South Afghanistan.

In general characters this species is not unlike *R. cyanophlyctis*, but is readily recognized by its broad head, sternal tubercular patches, and tubercular thumb-like nodosity below the first finger, as also by the tubercular dorsal surface of the first and second fingers.

XV.—*Description of two new* Curculionidæ (Ectemnorhinus) *from Marion Islands.* By CHARLES O. WATERHOUSE.

THE specimens which are the subject of this note were collected during the 'Challenger' expedition (on Dec. 26, 1873),

but were accidentally omitted in my account given in a former number of this journal (Ann. & Mag. Nat. Hist. xiii. 1884, p. 276). The discovery of two new species of the genus *Ectemnorhinus*, the species of which have hitherto only been found in Kerguelen, is interesting, especially as they are somewhat intermediate in their characters between *E. viridis* and *E. angusticollis* in the case of the larger species, and between *E. gracilipes* and *E. brevis* in that of the smaller.

Ectemnorhinus similis, n. sp.

Brunneus, sparsim viridi-flavo-squamulosus; elytris fortiter striatis, striis punctatis.

Long. $3\frac{1}{4}$ lin. (7 millim.).

This species is somewhat intermediate between *E. viridis* and *E. angusticollis**, but differs from both in being sparingly covered with minute elongate scales. The antennæ are very similar to those of *E. viridis*, but a trifle longer. The first and second joints of the funiculus are long, the first being a little longer than the second, whereas in *E. viridis* the first is a little shorter than the second; the third and fourth joints are at least as long as broad; the fifth, sixth, and seventh joints are a little shorter. The thorax is considerably narrowed in front and behind, convex, with a very slight indication of a median carina. Elytra at the base a little broader than the thorax (with distinct but very obtuse shoulders), considerably broader posteriorly; strongly striated, the striæ rather strongly punctured; the apex of each elytron broadly rounded. The claw-joints are rather larger than in *E. viridis*, but not nearly so large as in *E. Eatoni* (Ent. Mo. Mag. xiii. 1876, p. 51).

Slightly immature specimens have the legs yellow, and sometimes the elytra are yellowish.

Ectemnorhinus parvulus, n. sp.

Niger, parce viridi-squamulosus; antennis gracilibus; thorace angusto, medio carinato; elytris obovatis, fortiter striatis, striis fortiter punctatis.

Long. 4 millim.

This could only be confounded with *E. gracilipes*, which it closely resembles in general form and colour. It is, however, a little shorter, and more ample posteriorly. The funiculus of the antennæ is much more slender; the first and second joints long and slender, the third and fourth shorter, the fifth and sixth a trifle longer than broad, the seventh nearly globular.

* *Vide* Ent. Mo. Mag. xii. (1875) p. 55.

The rostrum is distinctly longitudinally impressed, the impression bordered on each side by an obtuse ridge. The disc of the thorax has a short but distinct ridge. The elytra are obovate, more strongly striated than in *E. gracilipes,* the striæ strongly punctured; the scales on the interstices long and narrow, but not hair-like as in *E. gracilipes.*

This species has the shoulders of the elytra bounded by a distinct ridge as in *E. brevis*, but that is a short and broad insect.

These specimens having been in alcohol it is probable that the paucity of scales may be due to abrasion.

XVI.—*On the Relationship of* Ulodendron, *Lindley and Hutton, to* Lepidodendron, *Sternberg*; Bothrodendron, *Lindley and Hutton*; Sigillaria, *Brongniart*; *and* Rhytidodendron, *Boulay.* By Robert Kidston, F.G.S.

[Plates III.-VII.]

At the meeting of the Royal Physical Society of Edinburgh, held on 21st March, 1883 *, I exhibited several specimens of the so-called genus *Ulodendron*, Lindley and Hutton. I then stated that I did not regard *Ulodendron* as forming a true genus, nor as entirely belonging to *Lepidodendron*, as some authors seemed to suppose; but that the genus, as usually employed by those who believe in its individuality, includes plants belonging to the genera *Lepidodendron*, *Sigillaria*, and *Rhytidodendron*†.

Almost all the misconceptions on the true affinities of *Ulodendron* have arisen through the neglect of a very essential element for the right understanding of these fossils, and one which only requires to be mentioned to be fully agreed in by all botanists, viz. that only *well-preserved examples* should be taken into consideration when critically considering the affinities of this genus; unfortunately this has not always been observed.

When determining the various species of the genera *Lepidodendron* and *Sigillaria*, unless the outer surface of the bark is well preserved and exhibits the form and arrangement of the leaf-scars, it is admitted that the plants do not show the

* Proc. Royal Phys. Soc. Edin. vol. vii. p. 356 (1883).

† Boulay, 'Le terr. houil. du nord de la France et ses végét. fossiles,' p. 39 (Thèse de Géologie), Lille, 1876.

characters by which a specific, or even in some cases a generic, determination can be made.

In *Ulodendron*, on the other hand, though it is difficult to account for it, decorticated and badly-preserved specimens, if only they show the characteristic Ulodendroid scar of the genus, have often been regarded as in a sufficiently good state of preservation, not only for generic identification, but even for the creation of new species, notwithstanding that the close affinity of *Ulodendron* and *Lepidodendron*, both in regard to their internal structure and general characters, is fully recognized. The form and size of the Ulodendroid scar have commonly been made the characters on which the various species of *Ulodendron* have been founded, the descriptions generally mentioning as the chief distinguishing point "scar so long by so broad." Such arbitrary specific distinctions to be of any value must infer that the plant sprang into existence with the Ulodendroid scars fully developed. This view of course was never intended by the authors who described the various species characterized as indicated above; but to make the species of true value an inference of this nature is quite legitimate.

Before entering further on the discussion of this subject it is desirable to give an epitome of the views which have been held by the many botanists who have written on it. As it is now universally admitted that *Ulodendron* is Lycopodiaceous, no note is taken of the different opinions on this point which some of the older writers have advocated, who in turn allied it to the Coniferæ, Cactaceæ, &c.

In support of the views I have stated in regard to the genus *Ulodendron*, I shall describe specimens of three species of plants which bear Ulodendroid scars; and as these are plentiful at certain localities in Great Britain I have been enabled to study many beautifully preserved examples. The results of these investigations I now beg to lay before the readers of the 'Annals.' This I especially desire to do, as it explains more fully than could be done, without the aid of figures, the views adopted in the classification of these plants in the 'Catalogue of the Palæozoic Plants in the British Museum.'

The three species specially to be examined are:—

1. *Lepidodendron Veltheimianum*, Sternberg.
2. *Sigillaria discophora*, König, sp.
3. *Sigillaria Taylori*, Carruthers, sp.

I am sorry that it will be necessary to criticize the writings of several friends with whose views on *Ulodendron* I cannot

entirely agree. I hope, however, that the evidence here brought forward may be considered a sufficient foundation for the opinions I have adopted.

The subject is treated under four divisions:—

I. Epitome of the views of previous writers on *Ulodendron*.
II. Descriptions of specimens.
III. General conclusions.
IV. Synonymy and Notes on the three species specially considered in this communication.

I. Epitome of the Views of previous Writers on *Ulodendron*.

1817. Steinhauer. American Philosophical Society, vol. i. new series. (Communicated May 2, 1817.)—The earliest figured fossil plant which can be referred to *Ulodendron*, Lindley and Hutton, appears to be that described by Steinhauer in 1817 as *Phytolithus parmatus*. Under this name, however, he included two plants which belonged to distinct genera. His fig. 1, pl. vi., is referable to *Calamitina*, Weiss, and is probably *Calamitina Germariana*, Göppert, sp.*; that on pl. vii. fig. 1 is referable to *Lepidodendron*, and though the specimen does not show the form of the leaf-scars distinctly, the general character of the fossil points to the probability of its belonging to *Lepidodendon Veltheimianum*, Sternberg.

1820. Rhode. Beiträge zur Pflanzenkunde der Vorwelt.—Under the somewhat comprehensive title of "Schuppenpflanzen," this author gives, on pl. iii. fig. 1, a very fair figure of *Lepidodendron Veltheimianum*, showing the Ulodendroid scars. On the lower part of these scars (on the upper part, as represented by Rhode, whose figure is inverted) are seen the remains of the leaf-scars, and on the isolated Ulodendroid scar, figure 4 B of the same plate, the medial line of the leaf-scar is clearly indicated. Rhode believed that the Ulodendroid scars on this specimen were flowers, the leaf-scars on its surface the petals. Although this view is crude, his drawings of *Ulodendron* are not so inaccurate as is sometimes supposed. The other figures which he gives of these Ulodendroid Lycopods have not been taken from well-preserved specimens.

* Weiss, "Steinkohlen-Calamarien" (Abhandl. zur geologischen Specialkarte von Preussen und den Thüringischen Staaten, Band ii. Heft 1), p. 126 (1876). *Cyclocladia major*, Lindley and Hutton, 'Fossil Flora,' vol. ii. pl. cxxx., also appears to be referable to *Calamitina*, Weiss.

1823. Allan. "Description of a Vegetable Impression found in the Quarry of Craigleith," Trans. Roy. Soc. of Edinburgh, vol. ix. p. 235, pl. xiv. (Read Jan. 22, 1821.)—The figure given by Allan is a beautiful example of *Lepidodendron Veltheimianum*, showing the large Ulodendroid scars. This fossil is now in the Museum of Science and Art, Edinburgh, and is also the subject of pl. xviii. vol. ii. of Brongniart's Hist. d. végét. foss. A reduced figure of the same specimen is likewise given by Buckland in his 'Geology and Mineralogy,' vol. ii. pl. lxxvi. fig. 3; and, finally, Mr. Carruthers has figured a single Ulodendroid scar from the same example in the 'Monthly Microscopical Journal,' vol. iii. pl. xliv. fig. 4. Allan regarded the large scars as the impressions of flowers or fruit.

1825. König. Icones fossilium sectiles. (London.)—There is here figured on pl. xvi. fig. 194, without any description, a specimen of *Ulodendron* which König names *Lepidodendron discophorum*. This seems similar to the plant subsequently described as *Ulodendron majus* by Lindley and Hutton.

1826. Sternberg. Essai d'un exposé géognostico-botanique de la flore du monde primitif, fasc. iv. p. xii.—*Ulodendron* is here placed in the group "*Filices veræ*," under the name of *Lepidodendron ornatissimum*. Sternberg believed that the large scars marked the attachment of fronds to the stem.

1828. Brongniart. Prodrome d'une histoire des végétaux fossiles, p. 85.—*Ulodendron* is also included among the *Lepidodendra* by Brongniart, by whom it is called *Lepidodendron ornatissimum*, Sternberg.

1831. Lindley and Hutton. Fossil Flora of Great Britain, vol. i. pls. v., vi.—The name of *Ulodendron* was first applied to these fossils by Lindley and Hutton, whose genus may be defined as follows:—Stem covered with rhomboidal leaf-scars, and bearing two opposite rows of large circular or oval scars, indicating points from which "branches, or, more probably, masses of inflorescence," have fallen.

Their genus *Bothrodendron* (Fossil Flora, vol. ii. pls. lxxx., lxxxi.) is merely a decorticated condition of *Ulodendron*, notwithstanding that one of their descriptions is headed "Corticated" (to pl. lxxx.) and the other "Decorticated" (to pl. lxxxi.). This point will be further remarked on.

1837. Buckland. Geology and Mineralogy, vol. i. p. 475, and vol. ii. pp. 92–95.—Buckland adopts the views expressed by Lindley and Hutton, that the large circular or oval pits were caused by the pressure of cones on the bark, which subsequently grew up round their base. He also regarded the genus *Bothrodendron*, L. & H., as distinct from *Ulodendron*.

He defined *Ulodendron* as follows:—" Stem not furrowed, covered with rhomboidal marks. Scars of cones circular;" and *Bothrodendron*—" Stem not furrowed, covered with dots. Scars of cones obliquely oval." Buckland believed that the cones were only attached to the centre of the large scars, and that the furrows on the upper parts of the scars, which radiate from the *umbilicus*, were formed by the scales at the base of the cone pressing against the bark.

1837. Brongniart. Histoire des végétaux fossiles, vol. ii. p. 69.—Brongniart, as in his 'Prodrome,' here places *Ulodendron* among the *Lepidodendra*. On pl. xviii. he gives a figure of *Lepidodendron Veltheimianum* under the name of *Lepidodendron ornatissimum*; on pl. xix. four other figures of *Ulodendra* are given under the name of *Lepidodendron*; one of these (fig. 1), at least, if not all, belongs to *Sigillaria discophora*, König, sp. = (*U. majus*, L. & H.). Brongniart points out the peculiar character of the bark becoming fissured in those examples which bore the Ulodendroid scars, which is a character not common to most *Lepidodendra*. The presence of these furrows he thought indicated that the specimen possessing them belonged to the lower part of the stem, and that they were caused by adventitious roots bursting through the bark.

He argues that had the large scars been originally covered with the ordinary cauline leaves, they should follow the ordinary spiral series of the stem, which he says they do not, each disk showing in the cicatrices which cover it a series of spirals peculiar to itself *. Or if they were the impressions of the scales of the cone, which had completely effaced from the surface of the stem all traces of the organs that it bore, then the impressions of the appendicular organ on the stem should have been in an inverse order from the leaf-scales of the stem, because the extremities of the scales of the cone are convex and should have made depressions on the stem. On the contrary, the marks presented on the Ulodendroid scars are similar to those of the leaves on the stem.

1848. Hooker. " On the Vegetation of the Carboniferous Period as compared with that of the present Day," Memoirs of the Geological Survey of Great Britain, vol. ii. part ii. p. 427.—Of *Ulodendron*, Sir Joseph Hooker says:—" This very remarkable genus scarcely differs from *Lepidodendron* in internal structure: its external aspect widely differs from that of any plant, recent or fossil, with which I am acquainted. I have seen in collections specimens which have been fossilized, apparently erect, or, at any rate, under very

* See description of specimens Nos. 3 and 7.

different circumstances from those preserved in the shales over the coal. They present the appearance of a large unbranched zigzag trunk, with two rows (opposite one another) of alternating cup-shaped deep depressions, one at every projecting angle of the trunk. Mr. Dawes showed me a specimen preserved in sandstone, with a large organ, which he considers a cone, inserted into one of the cup-shaped depressions. I could not, however, form any conclusion concerning the real nature of this highly interesting example."

1848. Sauveur. "Végétaux fossiles des terrains houillers de la Belgique," Académie royale d. sciences, d. lettres et d. beaux-arts de Belgique.—On pl. lxvi., under the name of *Arthrocladion Rhodii*, is figured a large decorticated specimen of *Ulodendron*, representing that condition of the plant for which Lindley and Hutton proposed their genus *Bothrodendron*.

1849. Brongniart. Tableau des genres de végétaux fossiles, p. 42.—Brongniart here states his belief that *Ulodendron* may be only founded on a peculiar condition of *Lepidodendron*, but which, from the occurrence of the large circular scars, may perhaps deserve to be generically distinguished.

1850. Unger. Genera et species plantarum fossilium, p. 262.—*Ulodendron* is here regarded as forming a true genus, with which, however, is united *Bothrodendron*, L. & H.

1852. Göppert. "Fossile Flora des Uebergangsgebirges," Verhandl. der Kaiserl. Leop. Carol. Akad. d. Natur. vol. xxii. suppl.—In this work Göppert mentions four species of *Megaphytum*. One of these at least, his *Megaphytum dubium*, belongs to the so-called genus *Ulodendron*. Göppert himself expressed doubt as to the propriety of keeping this separate from *Lepidodendron Veltheimianum*; and on p. 191 he says: "I confess I am still in doubt concerning the existence of this species, it many times having appeared to me as belonging to *Sagenaria Veltheimiana*." The specimen to which his remarks apply (pl. xxvii.) cannot be placed in *Megaphytum*, and clearly belongs to *Ulodendron*, L. & H. The general character of *Megaphytum dubium* shows a great similarity (especially in regard to the arrangement and form of the large scars) to *Ulodendron Taylori*, Carr.; but from the fossil being decorticated, its specific identity cannot be satisfactorily determined.

1853. Tate. In the 'Natural History of the Eastern Borders,' by G. Johnston. (London.)—This author says on p. 302: "The *Ulodendron* was the most singular plant which flourished during the Carboniferous era. Specimens obtained from Alnwick Moor enable us to add something to the knowledge of its form. Its internal structure is the same as that of *Lepido-*

dendron; it possessed similar leaves and rhomboidal areolæ on the stem and branches. A specimen in Alnwick Castle shows that its mode of branching is dichotomous, like the *Lepidodendron*; but, in addition, there are rows of round or oval scars on opposite sides of the stem arranged vertically; and these scars continue upward on the same plane along the branches, while other rows commencing at the point of forking run up on the opposite side of the branches; the scars and the branches are all in the same plane. These scars appear to have been points of attachment of masses of inflorescence, which had consisted of sessile cones formed of imbricated scales in a manner similar to a fir-cone. The chief difference between *Lepidodendron* and *Ulodendron* would therefore be that the cones, bearing sporules or seeds, were placed at the end of branches on the former, but their position on the latter was in linear rows on the stem and branches."

The only species Tate mentions is *Ulodendron ornatissimum,* Sternberg, sp. Of this he says: "The fruit-scars of this species are large and beautifully sculptured; we have them 11 inches in circumference; the distance from each other varies—in some specimens they are in contact, in others 1 inch apart; the areolæ also vary in form; when well preserved they are rhomboidal, contiguous, and spirally arranged. Buckland's *U. Allani*, and Brongniart's *L. ornatissimum* are representations of different portions of the same species."

1854. Geinitz. Darstellung der Flora des Hainichen-Ebersdorfer und des Flöhaer Kohlenbassins.—Under the name of *Sagenaria Veltheimiana*, Geinitz figures some fine examples of *Lepidodendron Veltheimianum*, showing the Ulodendroid condition (pls. iv., v.).

1855. Geinitz. Die Versteinerungen der Steinkohlen-Formation in Sachsen, p. 34.—*Ulodendron* is again placed in *Lepidodendron* by Geinitz. He says: "The branch-scars stand quincuncially and sometimes in only two rows;" and, again, "The occurrence of these large branch-scars has given rise to the formation of the genus *Ulodendron*."

1855. Goldenberg. Flora Saræpontana fossilis. Die Pflanzenversteinerungen des Steinkohlengebirges von Saarbrücken, p. 18. Genus *Ulodendron*.—This author regarded the large Ulodendroid scars as marking the place from which cone-like branches had fallen, these cone-like branches being formed through the arrested development of ordinary lateral branches.

1857. Miller. Testimony of the Rocks, pp. 462 & 464.—On p. 462 Hugh Miller says: "The only terminal point of

Ulodendron I ever saw was nearly as obtuse as that of *Stigmaria.*" [*Note.*—The *Stigmaria* to which he refers is shown in a woodcut, p. 462 (fig. 128), of the same work. This example exhibits a truncated extremity.]

1860. Eichwald. Lethæa Rossica, vol. i. p. 137.—*Ulodendron*, in which is included *Bothrodendron*, is treated by Eichwald as forming a true genus. He believed that cones were attached to the Ulodendroid scars. Some of his figures are very instructive, and will be more fully referred to again.

1864. Macalister. Journ. Royal Geol. Soc. of Ireland, vol. i. —This writer suggests that *Ulodendron* might perhaps be *Cycadaceous*. He also points out the probable identity of *Ulodendron majus* and *U. minus*.

1868. Dawson. Acadian Geol. 2nd ed. p. 454.—Under the name of *Lepidophloios* Dawson includes "those Lycopodiaceous trees of the Coal-measures which have thick branches, transversely elongated leaf-scars, each with three vascular points and placed on elevated or scale-like protuberances, long one-nerved leaves, and large lateral strobiles in vertical rows or spirally disposed;" and he says:—"Regarding *L. laricinus* of Sternberg as the type of the genus, and taking in connexion with this the species described by Goldenberg and my own observations on numerous specimens found in Nova Scotia, I have no doubt that *Lomatophloios crassicaulis* of Corda and other species of that genus described by Goldenberg, *Ulodendron* and *Bothrodendron* of Lindley, *Lepidodendron ornatissimum* of Brongniart, and *Halonia punctata* of Geinitz, all belong to this genus, and differ from each other only in conditions of growth and preservation. Several of the species of *Lepidostrobus* and *Lepidophyllum* also belong to *Lepidophloios*. The species of *Lepidophloios* are readily distinguished from *Lepidodendron* by the form of the areoles and by the round scars on the stem, which usually mark the insertion of the strobiles, though in barren stems they may also have produced branches; still, the fact of my finding the strobiles *in situ* in one instance, the accurate resemblance which the scars bear to those left by the cones of the red pine when borne on thick branches, and the actual impressions of the radiating scales in some specimens, leave no doubt in my mind that they are usually the marks of cones; and the great size of the cones of *Lepidophloios* accords with this conclusion."

1869. Carruthers. "On the Structure of the Stems of the Arborescent Lycopodiaceæ of the Coal-measures (*Ulodendron minus*, Lindl. & Hutt.)," Monthly Microsc. Journ. Nov. 1869, p. 225.—The internal structure of the plant is described. Mr. Carruthers says of *Megaphyton*, which he unites with

Ulodendron, "*Megaphyton* is based upon amorphous casts of a portion of the interior of the stem of *Ulodendron*"*.

1869. Röhl. "Fossile Flora der Steinkohlen-Formation Westphalens, einschliesslich Piesberg bei Osnabrück," Palæontographica, vol. xviii. p. 138.—*Ulodendron* is regarded here as a subdivision of *Lepidodendron*, and only separated from this latter genus by the presence of the "large branch-scars."

1870. Carruthers. "On the Nature of the Scars in the Stems of *Ulodendron*, *Bothrodendron*, and *Megaphytum*, with a Synopsis of the Species found in Britain," Monthly Microsc. Journ. vol. iii. p. 144.—For specific distinctions in *Ulodendron*, which he believes to form a *true* genus, Mr. Carruthers places great value on the form of the umbilicus at the "base or centre of the pit." Speaking of the Ulodendroid scars, he remarks on p. 148: "There is not the slightest indication of scales in any of the large series of specimens I have examined." . . . "In attempting to make obvious what authors believed to be there, the drawings of *Ulodendron* frequently exhibit scale-markings." In proof of this statement he cites Buckland's and Brongniart's figures of the specimen originally figured by Allan; and it must be admitted that in these two cases the leaf-scars are much more prominent on the Ulodendroid scars than in the original, which is, as already mentioned, fortunately preserved in the Museum of Science and Art, Edinburgh. Mr. Carruthers also believes that the appendicular organ was articulated to the whole surface of the Ulodendroid scar, and constructs a diagram to explain how the vascular-bundle-scars on the surface of the large scars appear as little dots on its lower portion and as elongated furrows on its upper part. He says, p. 149: "The vascular bundles, rising upwards and outwards from the circumference of the vascular cylinder, would, in passing into the appendicular organ, penetrate the lower half of the articulating surface at right angles, and would consequently show as circular pits on the cicatrice; while the bundles on the upper half would penetrate the surface at a very oblique angle, and would consequently show in the cicatrice as more or less elongated furrows." . . . "In species like *U. transversum*, where the inverted cone of the scar has a descending direction, the smaller will necessarily have a more or less furrowed

* Note.—*Megaphyton*, Artis. I fear Mr. Carruthers cannot have seen good specimens of *Megaphyton*, as the scars on the stem of this genus, when well preserved, differ much from Ulodendroid scars. There appears no reason to doubt the correctness of the generally accepted view that *Megaphyton* is the stem of an arborescent fern.

aspect on the lower as well as the upper half of the scar. That the appendages were articulated to the stem by the whole surface of the scar cannot be doubted. In the want, however, of any observed specimen it is not so easy to determine what these appendages were. The specimen figured on pl. xliii. fig. 5 appears to me to throw considerable light on this matter. In this species the opposite series of scars are borne on swellings on the stem, and the downward aspect of the scars shows that the organs which sprang from them had a descending direction. That this is the true position of the stem is abundantly established by the dark carbonaceous patches which here and there are attached to it, and which are the bases of the leaves converted into coal. One of these patches from the other side of the stem from that shown in the drawing is represented the size of nature at fig. 6, and here it is seen that the traces of the leaves still remaining are imbricated over each other, and that the scars where the leaves are broken off are on the upper portion of each base. This clearly shows the natural direction of the specimen figured. The appendages, then, must have been adventitious roots in this specimen*. In the light of this specimen the form and direction of the scars, where their original depth is to any extent preserved, appear to corroborate this view. The appendage could not in any of them have been patent; indeed they seem to show that it must have passed out outwards and downwards."

Bothrodendron and *Megaphytum* are united by Mr. Carruthers with *Ulodendron*, which genus he describes as follows :—" Stem covered with rhomboidal scars of leaves, and having large round or oval conical depressions arranged in linear series on opposite sides, from which spring aërial roots; leaves acuminate with a median nerve."

1870. Schimper. Traité de paléontologie végétale, vol. ii. p. 38.—*Ulodendron* (with which *Bothrodendron* is included) is regarded by Schimper as a true genus. He believed that the trunk in *Ulodendron* was simple or little branched as in *Sigillaria*. He mentions that the leaf-scars, which somewhat resemble those of *Lepidodendron*, remain almost of the same size from the summit to the base of the stem, whereas in *Lepidodendron* the leaf-scars gradually increase in size as we recede from the summit to the base of the stem. The bark of *Ulodendron*, on account of the thickening of the trunk, seems to have become fissured instead of increasing in girth with the growth of the stem. He accepts Lindley and Hutton's opinion, that the large Ulodendroid scars bore cones.

* For notes on this specimen, see next part of this article.

In regard to the significance of these Ulodendroid scars he says they are the result of an unequal dichotomy of the stem, the alternate dichotomies being barren or fertile—the barren going to form the axis of the stem, the other to form the fertile branch, from which eventually results the Ulodendroid scar. The thong-like impressions, which one almost always notices, especially on the upper part of the large scars, he ascribes to the impressions of the leaves at the base of the fertile branch.

1871. Weiss. Fossile Flora der jüngsten Steinkohlenformation und des Rothliegenden im Saar-Rhein-Gebiete, zweites Heft, p. 146.—This author does not express any decided opinion on the relationship of *Ulodendron* to *Lepidodendron*, evidently preferring to leave the matter an open question.

1872. Williamson. Philosophical Transactions, vol. clxii. p. 209, pl. xxvi. fig. 24; pl. xxvii. figs. 25, 26; pl. xxviii. figs. 27, 28.—The internal structure of *Ulodendron* is here described by Dr. Williamson, who says: "So far as all these portions of its organization are concerned this *Ulodendron* resembles the lowest type of *Lepidodendron*" (p. 210); and again, "It seems probable that these scars sustained objects which were chiefly developed from the epidermal layer and whose base rested upon the outer bark; they certainly were not roots or branches, and I incline to the belief that they were organs of fructification."

1875. Feistmantel. "Versteinerungen der böhmischen Kohlenablagerungen," Palæontographica, vol. xxiii. p. 194. —Feistmantel appears to have brought together in a confused manner *Lepidophloios*, *Lepidodendron*, and *Ulodendron*. Under *Halonia punctata*, L. & H. sp. (*Bothrodendron punctatum*, L. & H.), is figured on pl. xlvii. a Ulodendroid stem, beneath which is printed "*Halonia punctata*, L. & H. Decorticated state of *Lepidodendron laricinum*, Sternberg;" but this plate is also mentioned in the letterpress as an illustration of *Lepidophloios laricinus*, Sternberg. On his pl. xlvi. is shown a specimen of "*Ulodendron majus*, Sternberg (?), probably only a form of *Lepidodendron*." This plate is very roughly executed, but from the form of the leaf-scars probably represents *Sigillaria discophora*, König, sp. (= *U. majus*, L. & H.). His pl. xlvii. may also belong to this species; but from the state of the preservation of the specimen, it is quite impossible satisfactorily to settle the point.

1875–77. Stur. Culm Flora, pp. 262, 267, 270, and 283. —Stur unites *Ulodendron commutatum*, Schimper (= *U. parmatum*, Carruthers), with *Lepidodendron Veltheimianum*, and

believes that the Ulodendroid scars bore detachable bulbils. As to the organs which were attached to the large scars, he draws into the discussion the figure of *Lepidophloios laricinus* given by Goldenberg in his 'Flora Saræpontana fossilis,' pl. xvi. fig. 6. Of this figure Stur says (p. 263): "Goldenberg has made known to us the under portion of the bulbils of *Lepidodendron*. In the cited figure he has brought to our knowledge a bulbil-bearing *Lepidodendron*-stem, under the name of *Lepidophloios laricinus*, Sternberg."

So far as immediately concerns *Ulodendron*, L. & H., the figure of *Lepidophloios laricinus* given by Goldenberg and referred to as above by Stur must be omitted from the discussion, for on no account can *Lepidophloios* be united with *Lepidodendron* as now defined, or with *Ulodendron* as defined by Lindley and Hutton—*Lepidophloios* forming, in fact, a very distinct genus, which is separated from *Lepidodendron* by well-marked characters, its leaves being attached to downward directed cortical cushions whose leaf-articulating surface is placed at the lower extremity of the cushion, and is not surrounded by a "field" as in *Lepidodendron**.

Ulodendron has two rows of large, depressed, oval or circular scars, whereas the fruiting portion of *Lepidophloios* (*Halonia*, L. & H.) has four or more rows of tubercles, which in structure are also quite distinct from those of *Ulodendron*. Therefore, when considering the affinities of the genus *Ulodendron*, L. & H., the introduction of the genus *Lepidophloios* into the discussion can only further complicate the subject, as *Lepidodendron*, *Sigillaria*, and *Ulodendron* are essentially distinct, generically, from *Lepidophloios*. The statement made by Stur (p. 370), "that the bulbil-buds do not in all *Lepidodendra* occur exactly in two rows, but may also occur on the stem in more rows, the above-mentioned figure of Goldenberg proves, on which the bulbils are arranged in four rows," appears to be founded on a misconception of the true generic characters of *Lepidodendron*.

1880. Schimper, in Zittel and Schimper's 'Handbuch der Paläontologie,' Band ii. Lief. ii. p. 191.—The views mentioned in this work by Schimper are similar to those stated in his 'Traité de paléontologie végétale.' He recapitulates the evidence on which he has founded his opinion that the Ulodendroid scars mark the position of abortive branches, resulting from unequal dichotomy, and which have been modified for the purpose of fructification, in a similar manner to

* See fig. 7, Pl. IV., and figs. 14 and 15, Pl. VII., and explanations of these figs. in Explanation of Plates.

that which occurs in recent Lycopods, where the little cones are only modified branches. These modified branches, he believes, resulted in the formation of short-stalked cones; and he mentions the following objections to Stur's opinion that the appendicular organs were detachable bulbils:—1st, that when bulbils occur in the Lycopodiaceæ they are axillary, and when shed leave behind them no scar on the branch; and 2nd, that they never show the regularity in position that is shown in the scars of *Ulodendron*. Schimper here still regards *Ulodendron* as a true genus, and appears to think that the union of *Ulodendron* and *Lepidodendron* remains to be proved. He admits that *Lepidodendra* commonly occur with *Ulodendra*, but can be distinguished from the last-named genus by their larger leaf-scars and the absence of the Ulodendroid scars.

1880. Thomson, D'Arcy W. "Notes on *Ulodendron* and *Halonia*" (Trans. Edinb. Geol. Soc. vol. iii. part iii. p. 341). —This writer enters into a general discussion as to the affinities and structure of these plants. The conclusions he arrives at are:—

"1st. That the scars of *Ulodendron* and *Halonia*, though unequally developed, have similar significance.

"2nd. That these scars were points of attachment for the organs of fructification, and that these organs were cones or spikes, thicker and probably shorter than those of *Lepidodendron*.

"3rd. That in *Ulodendron* the cone was attached only to the central point of the scar; that the rest of this areola was originally covered with leaves after the fashion of the remaining portions of the stem; but was subsequently moulded by the process of growth on the lower surface of the cone.

"4th. That the oval form occasionally presented by the scars of *Ulodendron* is in all cases the result of secondary causes, and that this and the other slight modifications of shape and surface-markings in the scars are valueless as specific distinctions.

"5th. That the leaves of *Ulodendron* were small, narrow, lanceolate, and imbricate after the ordinary Lepidodendroid type, and that both *Halonia* and *Ulodendron* branched by repeated dichotomy in the usual characteristic manner.

"Finally, That *Ulodendron* and *Halonia* were closely allied Lepidodendroid plants; that on presumptive evidence Prof. Williamson's suggestion may still be retained, viz. that *Ulodendron* and the biserial '*Haloniæ*' may *possibly* represent portions of one and the same form; and that, in this

case, the specimens denominated *Halonia* formed the terminal or young branches of *Ulodendron*"*.

1880. Zeiller. Végétaux fossiles du terrain houiller de la France (extracted from vol. iv. De l'explication de la carte géologique de la France, p. 114).—This botanist writes: "At present several authors unite the *Ulodendra* to the *Lepidodendra*; I cannot see my way to adopt this view, at least in the case of *U. majus* and *U. minus*." . . . . "I do not pretend, however, that all the Lycopodiaceæ with branches provided with large circular depressions ought to be separated from the genus *Lepidodendron*, and that we might not meet with trunks of this genus presenting this peculiarity; practically it exists in the genus *Bothrodendron*."† . . . "I believe in the justice of regarding the genus *Ulodendron* as a special genus, distinguished from *Lepidodendron* by the mode of attachment of its leaves."

1880. Lesquereux. Coal Flora of Pennsylvania, p. 397.—This author practically adopts the views held by Schimper. As to appendicular organs Lesquereux thinks that in some cases they have been cones, in others "bud-like excrescences." This latter opinion is chiefly based on his *Ulodendron Mansfieldi* (pl. lxvii. fig. 2), which, I think, may perhaps not belong to Lindley and Hutton's genus *Ulodendron*.

1882. Renault. Cours de botanique fossile, deuxième année, p. 49.—*Ulodendron* is by this author treated as a true genus. He says: "Often a portion of the surface of these disks [Ulodendroid scars] is covered by the foliar cicatrices, a continuation of those of the trunk, but becoming a little smaller; it is necessary, then, that these disks should be understood as the flattened remains of a conical fleshy mamelon, of which the surface in continuation of that of the stem would have been covered with similar but smaller leaves. At the centre of the mamelon had been the axis of a caducous cone, of which the traces are indicated by the central umbilicus; the considerable number of vascular bundles which converge towards this part indicates a vegetative activity not in accordance with an abortive branch, but only with an axis, destined to bear organs of reproduction.

"We have separated from this genus, which is characterized by the form of the foliar cicatrices and by its biserial disks, two

* It is now conclusively known that "*Halonia*" is the fruiting branch of *Lepidophloios*; hence it cannot possibly be "terminal or young branches of *Ulodendron*."

† The plants placed in *Bothrodendron* by Zeiller are not similar to those included in *Bothrodendron* by Lindley and Hutton; but this point will be spoken of more fully presently.

forms, of which the one corresponds to *Lepidodendron Veltheimianum*, the other to *Lepidophloios laricinus*, and that because of their foliar cicatrices. We also separate for the same reasons the following species—*Ulodendron commutatum*, Schimper." . . . . "For our own part we regard *Ulo. commutatum* as identical with the strobiliferous trunks of *Lepidodendron Veltheimianum* of Stur, and as not requiring to be distinguished from it." . . . .

Renault appears to be mistaken in the views he holds of the relationships of *Lepidodendron Veltheimianum* and *Lepidophloios laricinus* to each other. Had he examined well-preserved specimens of *Lepidodendron Veltheimianum* in the Ulodendroid condition it seems impossible to imagine how Renault could have given such a figure of a "stem of *Lepidophloios* restored in part" as that shown at fig. 1 of his pl. xi. He says of this figure that it "represents a fragment of a trunk from the Coal-measures of Eschweiler and shows on its surface the characteristic cicatrices of *Lepidophloios laricinus*, but a little smaller." This description, I am afraid, is drawn up from the "figure in part restored" and not from the specimen. In the copy of Goldenberg's figure of *Lepidophloios laricinus* given by Renault on pl. ix. fig. 1, the articulating surface of the leaf is represented at the upper end of the cushion, its position being reversed from that represented by Goldenberg. This alteration in the figure on the part of Renault is erroneous, for most undoubtedly Goldenberg has drawn his plant correctly, and the same arrangement—a downward imbricating of the leaf-cushions—occurs also in *Lepidophloios scoticus*, Kidston*.

But to enable one to accept the view that two forms of leaf-scars occur in *Lepidodendron Veltheimianum*, one of the normal form and the other having a *Lepidophloios*-like leaf-scar, if Goldenberg's figure of *Lepidophloios laricinus* is to give any support to this opinion, it must be presumed that fig. 1, pl. xvi. of the 'Flora Saræpontana fossilis' represents the leaf-scars turned upside down. This is, however, not the case†. In fact, in the Ulodendroid condition of *Lepidodendron Veltheimianum there do not exist two types of leaf-scars*, but only the ordinary Lepidodendroid type; the appearance which has given rise to this mistaken view in regard to the Ulodendroid condition of *Lepidodendron Veltheimianum* will be referred to again more fully‡. Suffice it to say

* See figure of this plant given under name of *Lepidophloios laricinus* by Dr. Macfarlane (Trans. Edinb. Bot. Soc. vol. xiv. pl. vii.).

† See Weiss, Foss. Flora d. jüng. Stk. u. d. Rothl. p. 154.

‡ See the following part of this article.

that the sketch given by Renault on pl. xi. fig. 1, which shows three Ulodendroid scars placed on a stem bearing *Lepidophloios* leaf-scars, represented in inverse position, does not agree with any specimen which has come under my notice either in nature or in the literature of fossil botany.

Most authors have united *Bothrodendron*, Lindley and Hutton, with *Ulodendron*, and in this view I quite concur. Some of the figures which accompany these notes show on one or more parts of their surface a condition similar to that upon which Lindley and Hutton founded their genus *Bothrodendron* *. There are, however, some recent writers who still regard *Bothrodendron* as a true genus; to this view I must therefore shortly refer.

1880. Zeiller. Végétaux fossiles du terrain houiller de la France, p. 116.—*Bothrodendron* is thus defined by Zeiller: "Trunks marked with extremely small foliar cicatrices, rhomboidal in form, rounded at the angles, placed in quincuncial order, and each surmounted by a small cicatricule, corresponding probably to the insertion of a scale. Foliar cicatrices provided with three cicatricules, the central cicatricule placed slightly above the one on each side of it. The large trunks present, in addition, large circular depressions, more or less deeply concave and placed in two diametrically opposite vertical rows."

In *Bothrodendron* Zeiller mentions two species—one *B. punctatum*, L. & H., and the other *B.* (*Rhytidodendron*) *minutifolium*, Boulay, sp. This last-mentioned plant was described by Boulay as a typė of a new genus which he calls *Rhytidodendron* †. "This genus," Boulay says, "is characterized in the group of the arborescent Lepidodendreæ by the very distant, transversely elliptical, and very small leaf-scars, which form a small area with three cicatricules surrounded by an elevated border. These three cicatricules at once separate this genus from *Stigmaria*; the bark is delicate and finely wrinkled and chagrined transversely; after the decay of the bark we find on the trunk two elongated prominences corresponding to the cicatricules."

In his 'Végét. foss. du terr. houil.,' Zeiller does not give a figure of the specimen he places under *Bothrodendron punctatum*, L. & H.; but in his paper "Observations sur quelques cuticules" ‡, under the name of *B. punctatum*, on pl. ix. fig. 1,

* See Pl. VI. fig. 10, *d*; Pl. VII. fig. 13, *b*.

† 'Le terrain houiller du nord de la France et ses végétaux fossiles,' p. 39 (1876). Lille.

‡ Ann. des Sci. Nat. 6e sér. Bot. vol. xiii. p. 218, pl. ix. fig. 1.

he illustrates a specimen which agrees with his description in the work quoted. This figure and Boulay's *Rhytidodendron minutifolium* are justly placed in one genus by Zeiller; but my friend has evidently mistaken the true character of Lindley and Hutton's genus *Bothrodendron*. It is true that Lindley and Hutton, in the description of the two plates of *Bothrodendron punctatum* (Foss. Flora, pls. lxxx., lxxxi.), head their description to pl. lxxx. as "corticated," and, no doubt, this has misled Zeiller in the identification of the fossil he has named *B. punctatum*; still, in the description Lindley and Hutton say, "Upon the surface of the stem are discoverable a considerable number of minute dots, arranged in quincuncial manner, something less than half an inch apart, and it is probable that these may be the scars of leaves; *but at present there is nothing to prove that they were so*." It has since been proved that the little "dots" which Lindley and Hutton thought might prove to be leaf-scars, only mark the channels, on decorticated specimens, through which the foliar vascular bundles passed to the leaves. The types of *Bothrodendron* are now lost, but in the "Hutton collection" are several specimens of the so-called *Bothrodendron*, all of which are undoubtedly decorticated specimens of their *Ulodendron majus* or *U. minus*. Zeiller's *Bothrodendron punctatum* must therefore be placed in Boulay's genus *Rhytidodendron*, and not *Rhytidodendron* united with *Bothrodendron*, L. & H.

1882. Renault. Cours de botanique fossile, deuxième année, p. 51.—*Bothrodendron* is here also classed as a true genus, and Renault embodies, in fact, the description given of it by Zeiller. But Renault also treats *Rhytidodendron*, Boulay, as a distinct genus, and places it after *Bothrodendron*. I am quite of opinion that *Rhytidodendron* must be retained as a distinct genus, and in it must be placed *Bothrodendron*, Zeiller, but not *Bothrodendron*, Lindley and Hutton.

[To be continued.]

BIBLIOGRAPHICAL NOTICE.

Year-Book of the Scientific and Learned Societies of Great Britain and Ireland; comprising Lists of the Papers read during 1884 *before Societies engaged in fourteen Departments of Research, with the Names of the Authors.* Compiled from Official Sources. Second Annual Issue. 8vo. London: Charles Griffin & Co., 1885.

The number of Societies dealing with scientific matters, and especially with subjects of Natural History, has of late years become so great, and so many of the smaller ones, among a number of articles

of merely local interest, publish from time to time papers of more or less value, that it becomes a matter of considerable difficulty for the working naturalist to know what has been done upon any subject that may come before him. From this point of view the 'Year-Book of Scientific and Learned Societies,' of which the second issue is now before us, is a publication of considerable importance, and we can only hope that it may receive sufficient patronage to justify the publishers in continuing its production.

This second issue forms an octavo volume of 230 pages, and contains a list of societies, institutions, associations, clubs, and other similar bodies established for the cultivation of science, and including also some which hardly come under that denomination in the ordinary sense, being devoted to the study of agriculture and horticulture, law, literature and history, and medicine. By far the greater part of the bodies referred to, however, fall more or less strictly under the category of scientific societies, and of these we find detailed not only the titles and addresses, with generally the names of the presidents and other officers, but also complete lists of the papers read at their meetings during the year 1884, of the doings in which this second "year-book" is a record. The societies referred to in the volume are classified under fourteen heads, so as to bring together those which are established to perform similar functions, or to deal with the same or allied branches of knowledge, while the reference to any particular body is facilitated by the addition of a copious index arranged alphabetically.

PROCEEDINGS OF LEARNED SOCIETIES.

DUBLIN MICROSCOPICAL CLUB.

April 24, 1884.

Section of Schorliferous Quartz.—Prof. V. Ball showed a section of schorliferous quartz containing minute cells lined with a mineral dendritically arranged, possibly manganese.

Technitella legumen new to Irish Waters.—Prof. Haddon showed specimens of *Technitella legumen* (A. M. Norman) collected by Mr. Charles Elcock in the Irish Sea, near the Isle of Man; the first time it has been found in Irish waters.

Corynium Beijerinckii, a Fungus causing the "gumming" of Cherries.—Mr. Greenwood Pim showed *Corynium Beijerinckii*, a fungus said to be the cause of the gumming of cherries and other fruit-trees, other species producing "gum tragacanth" and similar products. The plant consists of a darkish, jointed, rather knotty mycelium, which produces 3–4-septate spores, broadly fusiform and somewhat constricted at the joints.

Gelatine Jelly simulating the "canal-system" of Eozoon canadense.—Prof. Sollas showed a thin slice of gelatine jelly containing groups of canals which curiously simulated in form, dimensions, and arrangement the canal-system of *Eozoon canadense.* They were obtained by slicing jelly frozen in Rutherford's microtome, and were no doubt caused by the crystallization of the water contained in the jelly into spicules of ice, which, afterwards thawing, left the canalicular spaces exhibited.

Parasitic Structure on Moss-leaves.—Mr. Archer showed leaves of a moss, which he owed to Mr. E. Parfitt of Exeter, bearing examples of what appeared to be either a form of adventitious bud or a true parasite growing on the edges and elsewhere from one of the leaf-cells. This growth formed a short, stout, cylindrical "filament," thick-walled and divided by four or five transverse septa, not obliquely sloped, as in protonematous growths. The cells, thus much shorter than broad, so formed were densely filled with coarse and scattered chlorophyll granules. Thus their growth presented at first glance a resemblance to some parasitic stigonematous algal form; but be it parasite or not, it certainly seemed that it could not be of that nature. It really seemed to be initiated by an outgrowth from one of the constituent cells of the leaf, and then the short stout filament, as described, formed by further transverse division; but its nature or purport remained a question.

Structure of Stem of Dracœna reflexa.—Prof. M'Nab showed a transverse section of the stem of *Dracœna reflexa,* showing circumferential growth by means of a meristem layer, which is to be regarded probably as the homologue of the interfascicular cambium of the dicotyledon, and that while the cambium of the dicotyledon gives rise to new wood, new bast, and new ground-tissue (medullary rays), the meristem gives rise in the tree Liliaceæ to the libero-ligneous bundles and ground-tissue.

May 15, 1884.

Peziza postuma from Potato-stalks.—Mr. Greenwood Pim showed *Peziza postuma* (Berk. et Wilson) growing from the sclerotia of potato-stalks, and which corresponded to the figures by Mr. Wilson in the 'Gardeners' Chronicle.' The whole plant *in situ* was exhibited, as well as a section under the microscope, showing sporidia &c. Mr. Pim had shown sections of the sclerotium to the Club a couple of years previously. The fully-developed *Peziza* from fruit was observed by Mr. Wilson in 1883. Mr. Pim's specimens were grown in damp Sphagnum in his greenhouse. He was indebted for the sclerotia to the kindness of Mr. Carroll, of the Model Farm, Glasnevin, who had received large quantities from various parts of Ireland, where last year it proved a formidable form of disease, quite distinct, of course, from the ordinary potato-murrain.

Section from Calf's Stomach.—Prof. Cunningham showed a section from a calf's stomach displaying the villi.

Presumed new Heliozoon discovered by Mr. Bolton near Birmingham.—Mr. Archer showed a sample from a gathering kindly forwarded to him by Mr. Bolton, of Birmingham, announced to contain a new and minute form of Heliozoon; but after a careful search through the material he had failed to find anything living, at all coming up to the expectation formed from Mr. Bolton's accompanying description. He had, however, met with, and now drew attention to, an organism which might, casually viewed, be regarded as a Heliozoon; but whatever might be the real nature of this, it could not be set down as appertaining to that group. This was globular, rather less than $\frac{1}{1000}$ inch in diameter, contents green, and rather thick-walled, and it was outwardly beset with numerous short, indistinct, subtruncate, subpellucid papillæ. Thus its radiate or stellate aspect lent this organism a certain amount of deceptive resemblance to a Heliozoon; but it could not be the organism referred to by Mr. Bolton, as it only distantly resembled his drawing. The gathering contained a quantity of *Euglenæ* passing into a vegetative condition by repeated self-division, and the conjecture presented itself, Might this globose papilliferous body represent an ultimate state of division of a *Euglena*, passed now into a globular thick-walled subspinulose resting form? But there was, further, in the gathering now and again to be detected an empty cell-wall, very thin, very hyaline, of a globular figure, and bearing a number of longish setæ or bristle-like hyaline spines, not unlike, only that these were notably more numerous, an empty skin of an example of the alga Mr. Archer had on a former occasion brought before the Club as *Oocystis setigera.* This too had the outline of a Heliozoon, but no sarcodic contents with green chlorophyll-bodies within, as depicted in the sketches, were present, and the longish bristle-like radii were clearly not pseudopodia, but rigid setæ. Here, then, was yet another object that might be taken at first glance for a Heliozoon, but it was obviously merely an empty cell-wall of great tenuity, not a globose sarcodic mass, however pellucid. It will be seen that it might be rather the evacuated cell-wall of some spore, to a certain extent of course calling to mind the zygospore of some Desmidian like *Staurastrum dejectum*, &c.; but it was, on the other hand, much more thin-walled and the radii were more slender and delicate than the empty cell-wall of such a zygospore, viewed under the same power, would appear to be. He had therefore missed what Mr. Bolton wished him to see; but it was nevertheless curious that, in so small an amount of material, two seemingly distinct things, superficially somewhat mutually alike, and both at the same time superficially like a minute Heliozoon, and both apparently novel in themselves, should occur. Mr. Archer really did know a minute Heliozoon, green, non-pulsating, with very slender pseudopodia, the green granules rather small and

somewhat densely filling up the mass—one to which he had never drawn attention, as its characteristics were found very difficult to determine; but it seemed certain that neither of the organisms here drawn attention to, nor, judging from Mr. Bolton's sketches, could his Heliozoon, be considered identical therewith.

Undescribed Epidermal Gland in Chiton.—Prof. Haddon exhibited transverse sections of *Chiton* (*Trachydermon*) *ruber* (Linn.), showing an undescribed epidermal gland at the posterior end of the animal on each side beyond the gills, which it is proposed to call the fenestral gland.

Development of Spicules in Geodia Barretti.—Prof. Sollas showed slices of *Geodia Barretti* in which the development of the globular spicules within a mother-cell could be traced through all the stages.

Cell-division in a problematic Chroococcaceous Alga.—Prof. M'Nab exhibited a slide of the Chroococcaceous alga from the wall of the stove at Glasnevin which contained the Desmids formerly exhibited. The material had been kept for about twelve months in a corked bottle, and the cells were dividing first into two and two, that is four cells placed linearly, and next into two transversely, so as to form two rows of four cells: all the cells remained in the gelatinous investment. The result of the division was the formation of eight very minute cells, whose further development was still under observation.

June 19, 1884.

Torrubia militaris new to Ireland.—Mr. Pim showed a section through the receptacle of *Torrubia militaris* which he had recently found growing (as is usual) from the body of a grub in Powerscourt demesne, near the Waterfall, being its first record, as far as he knew, in Ireland. The long and flexuous asci containing filiform sporidia are very striking.

Alcyonella fungosa exhibited.—Prof. Haddon exhibited *Alcyonella fungosa* in a living condition.

Archerina Boltoni, Lankester, *exhibited in a living condition.*—Mr. Archer presented for examination a group of four individuals of the new Sarcodine discovered by Mr. Bolton, of Birmingham, a specimen of which he had failed to find in the former gathering shown to the Club at last meeting. Here it was now "in the flesh," and a veritable novelty, which Prof. Lankester had done Mr. Archer and Mr. Bolton jointly the honour to designate, at least *pro tempore*, as *Archerina Boltoni*. As the group now under view showed, this is a more or less gregarious form, extremely minute

(say about $\frac{1}{1000}$ inch in diameter), orbicular, pellucid, containing one or two large chlorophyll-corpuscles, of elongate, somewhat kidney-shaped figure and smooth outline, and seemingly homogeneous texture, lying up against the periphery, thus leaving the centre more or less clear; the pseudopodia radiating in every direction, not very numerous, straight, very slender, long (say twice, thrice, or four times the diameter of the spherical body-mass), hyaline, clear; the outline of the body-mass sharp and smooth, not showing any pulsating vacuoles, nor allowing any nucleus to be detected. If a nucleus were present it might be supposed to be readily enough perceived in a body so clear as this, for even (now that we know that it is there) in the comparatively opaque and granuliferous body of *Actinophrys sol*, in certain examples, he thought it was not very difficult to detect the presence of the nucleus, even without dyeing. But the examples of this new form in the gathering were so few and far between, Mr. Archer had had no opportunity of experimenting to test the existence of a nucleus. No doubt the habit and appearance of this very minute form was that of a Heliozoon; but had it really no nucleus, what would it really be? Again, could it be possible that the very hyaline pellicular exuvium shown at last meeting has anything really after all to say to this organism? Could it be really possible that on becoming encysted it did not withdraw the pseudopodia, but became coated (body, pseudopodia, and all) in such a spinulose filmy envelope as that drawn attention to at the last meeting? If so, when the living protoplasmic substance withdraws therefrom, so as to leave behind the "spore-like" spinulose exuvium, the pseudopodia must pull themselves out of their minute tubular investments, and then escape (by a rent?) from the central globular portion. Is this pellucid integument composed of cellulose? All this would be very remarkable, and seems to indicate that this organism is at least most probably not a Heliozoon, much as it simulates one, but a Sarcodine of "lower" type. It is possible the great sharply-defined chlorophyll-masses might at some epoch become "zoospores" and perhaps "conjugate;" but this is only supposition. Mr. Archer learnt that Prof. Lankester was making a thorough examination with large material of this form, and it was to be hoped that he might be able to throw much light upon it. One thing at least was certain, that this was not the same green "Heliozoon" referred to by Mr. Archer at last meeting. At any rate, this is undoubtedly a new form; and Mr. Archer felt greatly indebted, so far as he was concerned, to Prof. Lankester for the honour done him in connecting his name with so interesting a novelty. He had also to thank Mr. Bolton very much for his courtesy and the pains he had taken to cause him at last to see the right thing.

A modified Microtome exhibited.—Dr. Scott exhibited a microtome devised by Dr. Hayes, Merrion Square, mainly on the model of the instrument by Junge of Heidelberg; but in place of the very great

delicacy which characterizes that instrument, this one was made rather roughly and strongly, rendering it more suitable for ordinary use. In place of a costly knife, of peculiar pattern, it worked with an ordinary razor, and was adapted for freezing tissues by means of ether. By a simple arrangement which Dr. Scott fitted to it, continuous series of sections of known thickness could be cut with ease. The price was also exceptionally low.

Chert with Sponge-spicules.—Prof. Sollas showed sections of chert from Lias with sponge-spicules.

Experiments to illustrate the Application of the Microscope to practical Mineralogical Questions, were shown by Prof. Tichborne. In examining an argentiferous mineral which was found in Wales, and known there as "blue stone," it became desirable to determine whether the said mineral was a definite double sulphide of lead and zinc, or whether it was a fine mechanical mixture of the two well-known minerals galena and blende. The said blue stone had been also found in Ireland at Ovoca, and being considered a definite mineral, had been christened Killmacooite, from a local name. Dr. Tichborne found that on gradually powdering the mineral and examining it from time to time under the microscope, a point was at length reached when half the particles became transparent and transmitted light, whilst no amount of powdering would render the other particles transparent. To try such an experiment it was necessary to view with very strong transmitted light (a half-inch object-glass) and to cut off all reflected light. From this experiment he came to the conclusion that the mineral was an intimate mixture of fine crystals of blende and galena, the blende being the transparent particles and the galena the opaque. Although both these minerals possess a certain degree of metallic lustre, galena is one of the most perfectly opaque substances known, whilst blende in very thin layers is perfectly transparent. Prof. Tichborne illustrated this by depositing thin layers of artificial galena and blende upon glass by the action of sulpho-urea upon alkaline solutions of the respective oxides of lead and zinc.

October 16, 1884.

Structure of Leaves of Abies subalpina, Engelm.—Prof. M'Nab exhibited sections of leaves of *Abies subalpina*, Engelmann, which he had collected in Kicking Horse Pass, Rocky Mountains, Sept. 12, 1884. These differed in no way from leaves of the type specimen of *Abies lasiocarpa*, Hooker, a species sent by Douglas from the very same region, and thus, according to the strict law of priority, Engelmann's recent name should be rejected.

Zygospore of Cosmarium cucurbita.—Mr. Archer showed the zygospore, or what appeared to be the zygospore, of *Cosmarium cucurbita*, collected by Mr. Pim at Killarney a few weeks previously. This formed a somewhat elongate, on the whole subelliptic figure,

the surface elevated into a number (say probably ten or twelve) of large hemispherical prominences; thus the whole presented a very broadly undulate outline. The cell-wall was thick, destitute of any processes beyond the somewhat tall rounded prominences, as mentioned. The chlorophyll-contents dense and remaining of a bright green. The identification of this pretty object as the zygospore of the species mentioned rested upon the presence of a pair of empty semicells, seemingly involved with it, and in just the position they ought to assume if they really were the halves of one of the parent-cells; of course this assumption would have been enormously fortified, if not indeed absolutely determined, had the empty semicells of another parent-cell been found in a corresponding position. At any rate, there could be but little doubt that this really was a spore; and if the assumption as to its identity be correct, this would seem to be the first record of the zygospore of that very common species. Indeed it is rather curious how *rarely* some of the *common* species of *Desmidieæ* are met with conjugated, though others, indeed, are frequently so encountered. The present zygospore has little resemblance to any other, and at least could not be mistaken seemingly for any described. Perhaps of all forms known it had most resemblance to that of *Penium phymatosporum*, a not uncommon species, of which, however, Mr. Archer had only once seen the zygospore; but, as might be expected from the relative size of the species, the present zygospore is far smaller, and, though seemingly elongate, is not subquadrate and compressed; it is, as mentioned, in general form elliptic, and might be described as broadly undulato-ovate. It has a certain resemblance, too, to the zygospore of one at least of three common forms, confused under the name *Cosmarium margaritiferum*, which, however, is greatly larger, spherical, and its hemispherical prominences, in proportion to the bulk of the total mass of the zygospore, not nearly so elevated.

Gelatinous Alga from a Geyser-basin, Yellowstone Park, Wyoming.—Mr. G. F. Fitzgerald exhibited some morsels of a gelatinous growth which he had found in the "Prismatic Pool" in the middle of a Geyser-basin, Yellowstone Park, Wyoming, United States. The mass from which he had taken the specimens grew to a distance of about 5 or 6 feet nearly all round the edge of the pool, which was about 30 yards in diameter. The water of the pool overflowed its edge almost throughout, and it was in this overflow water that the jelly-like substance grew. The temperature of the water was from 100° to 120° Fahr. It grew on what appeared to be a flat tuffa rock, deposited out of the water of the pool, and covered it very uniformly to a depth of about an inch to an inch and a half. Its upper surface was somewhat lumpy, very much like the thick moss that grows in cushions on the tops of walls, when the cushions get close enough to make a continuous surface. The upper surface was bright red, but below it was a nearly clear jelly of about the consistency

of a slimy stiff calf's-foot jelly. Under the top surface there were a series of what appeared like surfaces of growth that gave a vertical section somewhat the appearance of some agates.

November 20, 1884.

Canadian Specimen of Cosmarium notabile, Bréb.—Mr. Archer drew attention to specimens of *Cosmarium notabile*, Bréb., a rather small form, found in a Canadian gathering made by Prof. M'Nab on his recent visit. This is far from a common species here at home, but can hardly be called a rarity. It seems to be a constant form, though differing slightly in dimensions. Very few other forms occurred in the Canadian gathering, and none seemingly very noteworthy. A Palmellaceous algal form occurred in the gathering, of which Dr. M'Nab showed a slide. Some of the examples presented the appearance of a slipping out of the protoplasmic contents of certain of the cells *en masse*; some seemingly showing this phenomenon in a more remarkable manner Mr. Archer had met with in some of the material Dr. M'Nab had given him.

Nostoc calidarium, Wood, *from Geyser-basin, Wyoming.*—Dr. E. Perceval Wright showed a few mounted fragments of the gelatinous alga from the Geyser-basin, Yellowstone Park, Wyoming, which had been collected by Mr. G. F. Fitzgerald, and exhibited at the previous meeting of the Club. The mass seemed to be composed of a matting together of several algal forms, the prominent species in which was a *Nostoc*, very possibly *Nostoc calidarium*, Wood, a species described as found in a thermal spring in the northern portion of Owen's Valley, California, the temperature of the water being between 110° and 120° Fahr., or about the same as that of the water in which the specimens exhibited vegetated. Although the two sets of filaments referred to by Wood were present in the mass, no heterocysts had been detected. The other forms found were a *Chroococcus*, pretty generally diffused, and much more sparsely an *Oscillatoria*, provisionally *O. Fröhlichii.*

Aregma (Phragmidium) obtusum, Link, *exhibited.*—Mr. Greenwood Pim showed *Aregma (Phragmidium) obtusum*, Link, which occurred on leaves of the "Barren Strawberry" (*Potentilla fragariastrum*), in Hollybrook, near Bray, last autumn. This form is very distinct from those occurring on the bramble, rose, and raspberry, one of which was shown for comparison, in being quite obtuse at the apex of the spore and having a very short stalk. It appears rare, this being its first notice in Ireland, but occurring on a small and insignificant plant may probably often escape detection. It is curious that the three closely allied genera *Aregma*, *Xenodochus*, and *Triphragmium* are confined to members of the natural order Rosaceæ, whilst the extensive series of *Puccinias,* also nearly related, are found on various natural orders, Rosaceæ being almost exempt.

Myliusia Grayi.—Octahedral nodes of the skeleton, in comparison with those of *Dactylocalyx pumiceus* in the young state, were shown by Prof. Sollas.

Ctenodrilus, sp., a living example, was shown by Prof. Haddon.

December 18, 1884.

Plant-remains from Silurian Rocks.—Prof. Sollas showed a section from Silurian rocks presenting what seemed to be plant-remains, forming, in a longitudinal view, long drawn out, large, and thick-walled, variously sized non-septate tubes, and in a transverse view presenting each a circular outline, these involved in a common matrix.

Section of Quartz-trachyte, or Liparite, from the Neighbourhood of Smyrna, was shown by Prof. Hull, F.R.S. The district is well known to be rich in volcanic rocks of Tertiary age, consisting of trachytic, augitic, and other varieties of rock, together with tuffs and agglomerates, on a mass of which last the ancient castle is built.

The section exhibited is taken from a grey porphyritic rock, containing numerous crystals of sanidine, plagioclase, minute grains of quartz, crystals of biotite, augite, hornblende?, sub-crystalline forms of vesuvian, and magnetite in small quantity in octahedral grains—in all about eight varieties of minerals set in a "ground-mass" (or paste) of glass.

The ground-mass requires a rather high power for observation, and is seen to consist of a glass traversed by multitudes of trichites and microliths, together with minute colourless prisms of apatite, quartz grains, and crystals of plagioclase. The quartz grains, both large and small, are also seen to contain numerous cavities, some with fluid, some containing "dust" or specks of magnetite (?),

From the above account it will be inferred that, with the polariscope, the section offers a very beautiful appearance, the various minerals displaying their coloration with ever varying effects as the polarizer is made to rotate.

On the whole it would appear that the rock answers pretty well to the description of "Liparite" of Roth, as given by Zirkel ('Mineralien und Gesteine,' p. 345) and Rosenbusch ('Mikroscopische Physiographie d. Mineralien,' Band ii. p. 138).

Remarkable Spore or Spore-like Body from the Carboniferous Formation.—Prof. Haddon exhibited a spore or spore-like body found in a section from the Carboniferous formation, Halifax, forming a very pretty object, much resembling some desmidian zygospore in its orbicular figure, beset all over by numerous short processes of equal length, causing the whole to present a stellate aspect.

Sphæroblasts from Stem of Privet (Ligustrum vulgare).—Dr. M'Nab exhibited a section of an arrested bud from the stem of

the privet (*Ligustrum vulgare*), the specimens of which were sent to him by Mr. Greenwood Pim. The arrested buds were numerous on the stem and were not arranged in any special order, so that there were probably both normal and adventitious buds, converted into sphæroblasts, like those so well known on the stem of the beech. Two peculiarities were noticeable: first, that the sides of the bud had four rows of leaf-scars, all internodes having been suppressed; and second, some of the arrested buds had produced opposite lateral buds, right and left, at their base, thus forming a three-lobed structure. The transverse section, shown under the microscope, exhibited a very remarkable contorted condition of the wood, with only slight traces externally of medullary rays. Both pith and cortex were well developed. The vessels were few and small, and the whole appearance was very different from that of normal privet-wood.

Photographs of Diatoms exhibited.—Prof. Haddon showed some fine photographs of Diatoms, from the War Museum, Washington, made under a very large amplification (2000–3000 diam.) of great beauty and clearness.

Prof. E. Perceval Wright showed examples and drawings of a new genus and species of *Alcyonaria* from the 'Challenger' collection.

Variety of "Grit" from Bray Head exhibited.—Prof. V. Ball, F.R.S., exhibited a section of a dense purple-coloured rock which is found near the southern extremity of the section of Cambrian rocks forming Bray Head. The mode of occurrence of this rock being for the most part obscure, although at one point it is distinctly stratified, this, together with its density and hardness, made it desirable to examine its microscopical characters. It proves to be a distinctly clastic rock, consisting mainly of small fragments of quartz in a ferruginous matrix. It may be regarded as a somewhat exceptional variety of the class of rocks of this age to which the term "grit" used to be applied by Prof. Jukes.

GEOLOGICAL SOCIETY.

April 15, 1885.—Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., President, in the Chair.

The following communication was read:—

"Notes on the Polyzoa and Foraminifera of the Cambridge Greensand." By G. R. Vine, Esq. Communicated by Thomas Jesson, Esq., F.G.S.

After commenting on the want of published information concerning the Polyzoa of the Cambridge Greensand, as shown by the

fact that none are mentioned in Mr. Jukes-Browne's list of the fossils (Quart. Journ. Geol. Soc. xxxi. p. 305), the author proceeded to explain the circumstances under which he had been entrusted with the whole of Mr. T. Jesson's collection from the coprolite-bed for description. The collection is large and important, and the Polyzoa contained exhibit a facies distinct from that of the Jurassic beds on the one hand and of the Upper Chalk on the other. There is but little similarity between the collection now described and the forms known from Warminster and Farringdon. The majority of the Cambridge-Greensand Polyzoa occurred unattached to any matrix; but several examples of attachment have been observed, chiefly to *Ostrea*, *Radiolites*, and species of *Cidaris*.

A list showing the range of the species described preceded the actual descriptions of the following kinds of Polyzoa and Foraminifera, with notes on their relations &c. It included:—

POLYZOA.

Stomatopora gracilis, *Milne-Edw.*
Idmonea dorsata, *Hagenow.*
Entalophora raripora, *D'Orb.*
—— Jessonii, sp. nov.
—— striatopora, sp. nov.
—— gigantopora, sp, nov.
Diastopora cretacea, *Vine.*
—— ——, var. lineata, var. nov.
—— fecunda, sp. nov.
—— megalopora, sp. nov.
Lichenopora, sp.
—— ? paucipora, *Vine.*
Dromopora stellata, *Goldfuss.*
—— polytaxis, *Hagenow.*
Osculipora plebeia, *Novall.*
Truncatula, sp.
Membranipora cantabrigiensis, sp. nov.
Microporella, sp. (? antiquata).
Lunularia cretacea, *Defr. & D'Orb.*

FORAMINIFERA.

Webbina lævis, *Sollas.*
—— tuberculata, *Sollas.*
Trochammina irregularis ?, *D'Orb.*
Textularia, sp.

MISCELLANEOUS.

On the Existence of a Nervous System in the Acœlous Planariæ and of a new Sense-organ in Convoluta Schultzii. By M. YVES DELAGE.

THERE are in the animal kingdom a small number of creatures with differentiated tissues in which no nervous system has been recognized. Nevertheless the well-known existence in them of sense-organs almost enables us to assert *à priori* that of ganglionic cells and of nerves. Among these creatures are the lowest Planariæ included in the group of the Acœlous Rhabdocœla. In the most recent and the most authoritative work upon this subject, that of L. Graff, these Planariæ are described as having no nervous system. Nevertheless a Russian zoologist, Mlle. Pereyaslawzew, speaking inciden-

tally of the adult in a note treating of the development of the embryo of the Acœla, says:—"I have found the nervous system in the adult Acœla, as well as the digestive cavity, perfectly visible in sections." All our knowledge upon this subject is limited to this phrase, which is not followed by any description or accompanied by any figure.

In one of our most interesting Acœla, *Convoluta Schultzii* (O. Schm.), I have discovered a very developed nervous system, and I have been able to display it with the greatest distinctness, not only in sections, but in the animal when entire.

Nervous System.—Around the otocyst we find a bilobate ganglionic mass, which forms the principal part of the central system. Two other masses, forming a pair, smaller and situated higher up *, are attached to the principal mass by two large connectives, and are united to one another by a transverse commissure. These central parts of the nervous system are composed of fibres and cells. The fibres occupy the centre of the dilated parts, and form almost the whole of the connective and commissural cords. They are exceedingly fine and delicate, undulated and parallel. The cells are situated at the periphery of the dilated parts, and form especially a great aggregation at the postero-inferior part of the principal mass, and a continuous layer around the otocyst. They are of an average diameter of 5 μ to 7 μ, and are polyhedral. In some of them one can see starting from the angles processes which throw themselves into the layer of fibres. Their single nucleus, which is not nucleolated, is 3–4 μ in diameter.

The peripheral system is formed by six parallel longitudinal nerves and their ramifications. These nerves are situated immediately underneath the layer of zoochlorellæ; they form three pairs—an external one, which runs in the folded margins of the body; an internal one, which descends a little beyond the median line; and an intermediate one, situated at nearly equal distances between the two preceding. These last two pairs correspond to the four clear streaks which may be observed in the living animal without any preparation. The internal nerve on each side originates from the principal ganglionic mass which surrounds the otocyst. The two external nerves originate by a short, common, transverse trunk from the small superior mass. A cord starting from the inferior ganglion joins the median nerve at its origin, so that the latter has a double origin. These longitudinal trunks are united by transverse anastomoses, which cut them at right angles, like the rungs of a ladder. These anastomoses are not all perfectly constant in their position, but the variation is not considerable. In a general way they become more and more numerous the further they are from the head. At the inferior extremity the cords converge and resolve

* As usual I place the animal with the head upwards and the ventral surface in front.

themselves into a rich plexus. From the principal cords and from the anastomoses issue numerous very fine filaments which anastomose among themselves so as to form a network with square or rectangular meshes. The nerves are composed of the same fine fibres as the commissures of the central system.

Sense-organs.—Besides the otocyst, notwithstanding what Graff has said, there exist two eyes, represented by two yellow pigment-spots, and I have recognized the existence of a new sensitive apparatus which I shall name the *frontal organ.* It is an ovoid, clear, refringent mass, situated at the superior terminal extremity. It measures about 0·04 millim. by 0·03 millim. The larger end of the ovoid is situated at a small distance from the highest commissure of the nervous system, or even reaches it; the smaller end is applied against the integuments, which, at this level, are destitute of cilia and furnished with short conical papillæ regularly arranged. The mass is bounded at the sides by a double layer of ganglionic cells. A small number of cells of the same kind exist in its interior. From the bounding cells, the central cells, and the nervous commissure start numerous very fine filaments which anastomose in the refringent mass and form a network; then the filaments gradually approach other and converge regularly towards the superior extremity, where they terminate each in one of the papillæ mentioned above. In a great many cases I have been able to trace the filaments from the cells in which they originate to the terminal papilla. The refringent matter performs the function of a sustaining substance. The whole apparatus is very mobile, and the animal seems incessantly to feel about with the papillæ which terminate it.

In young *Convolutæ* just hatched and still destitute of zoochlorellæ the frontal organ exists even more highly developed in proportion than in the adults, and I have been able to demonstrate the nervous system, which is constituted as in the adult, but less condensed and less rich in ramifications.

Lacunæ of the Reticulum.—The nerves appear everywhere surrounded by an endothelial sheath, the cells of which, smooth and flattened on the side towards the nerve, are continuous externally with those of the reticulum. The cavity included between the nerve and its sheath is not entirely virtual. By means of a certain reagent which I shall make known we can demonstrate the existence of a cavity between the nerve and its sheath, and this cavity is continuous throughout with a very highly developed system of lacunæ, which occupies the whole of the zoochlorella-layer. Each of these Algæ is enclosed in a free cavity, and the spaces interposed between these cavities are formed by the lacunæ in question. More circumstantial details upon this point will be given in my forthcoming memoir.

The German zoologists have reproached M. Blanchard with having injected the nervous system of the Planariæ, and described this

nervous system as a circulatory apparatus. But a nervous system is not a hollow organ capable of being injected, and the imputation seems to have been made a little inconsiderately. The discussion not having related to the Acœla I do not know how far my results may apply to the Planariæ injected by M. Blanchard; but in all a sheath seems to exist around the nerves, and if the contiguous lacunæ also existed, we should have in them a natural explanation of all the difficulties, and the proof that the mistake has not been entirely on the side of the French zoologist.—*Comptes Rendus*, July 20, 1885, p. 256.

The Nest of the Fifteen-spined Stickleback. By Prof. KARL MÖBIUS.

Among the fishes of the Bay of Kiel the sea-stickleback (*Spinachia vulgaris*, Flem.) is distinguished by the remarkable instinct of constructing a nest for its eggs and young. For this purpose it employs delicate plants which grow in the shallow water, and masses these upon *Zosteræ* or the fronds of seaweeds which wave below the surface of the water or on the piles of landing-stages, until they form a soft rounded mass of 5–8 centim. in diameter. In this nest the female, in May or June, deposits several masses of ova, and the male surrounds the nest with white silky threads and then keeps watch by it.

All this has long been known, but exact knowledge of the constitution of the threads and the place of their origin has hitherto been wanting. The examination of male sea-sticklebacks in May and June 1884, enables me to state that the threads are usually from 0·12 to 0·13 millim. in diameter, and consist of several cords stuck together, which, again, are composed of very fine parallel threads. The substance of which they are composed is nitrogenous, and is a peculiar modification of mucine, as appears from its behaviour towards various acids and alkalies. It is *formed* in the kidneys of the male, and, indeed, in the *epithelial cells of the urinary canals*, which exert this form of activity only at the time of reproduction, and during this period behave towards staining reagents in the same way as the muciferous organs of other Vertebrata.

The kidneys of mucus-bearing sea-sticklebacks are inflated, especially at their posterior extremity. From the kidneys the mucus passes through the ureters into the bladder, which is thereby dilated into a large pyriform vesicle, from the opening of which the mucus finally oozes out as a white thread-forming mass and attaches itself to solid objects that it touches. A male stickleback from the urinary aperture of which mucus protrudes therefore needs only to move around the nest in order to spin round the masses composing it and the adherent ova.—*Schriften naturwiss. Vereins für Schleswig-Holstein,* Band vi. Heft 1, 1885.

Freia ampulla, *the Flask-Animalcule.*
By Prof. KARL MÖBIUS.

One of the largest and finest Infusoria of Kiel Bay is *Freia ampulla*, O. F. Müll., the flask-animalcule. When full-grown and completely extended it is nearly 1 millim. long and 0·1 millim. broad, so that it is perceptible even with the naked eye. It resides in a flask-shaped capsule with a convex bottom, a short neck, and the margins of the aperture bent outward. This capsule is transparent, brownish yellow or somewhat bluish, and consists of a chitinous substance which is insoluble in potash. The greater part of the extended animal is cylindrical. Its posterior extremity is attached to the bottom of the capsule, while the anterior portion can reach far beyond the aperture of the capsule, and is divided into two lanceolate lobes, the bases of which are united to form a half-funnel, in the bottom of which the mouth is situated. The edge of these funnel-lobes is covered with combs of cilia or pectinellæ, the united bases of which cross the edge-line nearly at right angles. The pectinella-fringes of the two funnel-lobes run spirally down the funnel as far as the mouth.

When the animalcule has extended itself and separated the funnel-lobes it sets a portion or the whole of its pectinellæ in motion, and thus produces currents which carry smaller Infusoria, unicellular Algæ, or granules of indigo or carmine mixed with the water into the cavity of the mouth. When the latter is filled it opens inwards and allows the food, in the form of a rounded ball, to pass into the œsophagus, which may be recognized as a longitudinally-striated canal behind the mouth, in the middle of the fore part of the body. From the œsophagus the food-balls pass into the soft endosarc of the middle and hind body; many food-balls are also pushed up forward even into the endosarc of the funnel-lobes. The indigestible parts are expelled at the base of the left funnel-lobe. Several fæcal balls usually collect to the left of and somewhat behind the bottom of the funnel, in a canal, a sort of rectum, and escape quickly one after the other.

The soft endosarc is covered with a firmer layer of ectosarc, which consists of long streaks beset with greenish-brown granules. These streaks act like muscular fibres. When they contract, the hind-body becomes thicker and applied to the bottom of the capsule, while the fore-body with the funnel-lobes folded together passes down below the aperture of the capsule. *Freia ampulla* usually retracts itself quickly into the capsule, and only slowly extends itself again.

In the middle and hinder parts of the body there is a light necklace-like cord, which is coloured red by solution of carmine. This is the *nucleus*.

In many capsules there is, at the side of the hind-body of a perfectly developed individual, a young animal without funnel-lobes, nearly uniformly rounded off anteriorly and posteriorly, and produced by fission from the body of the parent animal. This, when it

is still connected with its parent only by a slender cord, stretches the fore part of the body out of the capsule, tears itself free, and swims away, carried along by fine cilia which cover the whole body in close longitudinal series. At the anterior extremity rudiments of pectinellæ already show themselves, and a slight notch is the beginning of the formation of the funnel-lobes. After the young animal has swum about freely for a time it attaches itself to some firm support and secretes the material of the capsule as a transparent mass, thicker behind than before, where it is not yet turned out as in mature individuals.—*Schriften naturw. Ver. für Schleswig-Holstein*, Bd. vi. Heft 1 (*Kiel*, 1885).

On Adamsia palliata. By M. Faurot.

The constant association of *Adamsia palliata* and *Eupagurus Prideauxi* has long been known without having been made the object of any special investigation. This association is equally for the benefit of both animals—abundant and well-prepared food for the *Adamsia*, the mouth of which is placed behind the foot-jaws and chelæ of its associate, and a shelter adapted to the peculiar structure of the *Eupagurus*, the ambulatory legs of which, extending far at the sides and remarkably active, could not move easily with a dwelling which was not so exactly fitted to the form of the animal. Thus *Eupaguri* captured in the open sea and destitute of *Adamsiæ* present, attached to the extremity of their abdomen, gasteropod shells, which are always of very small dimensions, so as not to interfere with the movements of the ambulatory feet. Hence when these animals live separated from their habitual associate they are imperfectly sheltered.

Another proof of the peculiar function of the *Adamsia* is that in the association of two adult individuals the size of the Actinia is always in relation to that of the crustacean, while the shell is most frequently of very small dimensions. The latter therefore serves chiefly as the common point of fixation of the two creatures.

Whatever may be the deformation presented by the adult *Adamsia*, its anatomical structure is morphologically the same as that of other Actiniæ. It more particularly approaches that of *Sagartia parasitica* (*Adamsia Rondeletii*, Carus), the foot of which likewise secretes a layer of mucus which acquires a membranous consistency. The two species are furnished with six pairs of large primary septa and six secondary, equally remarkable for their breadth; the former are provided with sexual glands throughout their whole extent, and advance much beyond the other folds towards the middle of the gastric cavity. In both the *acontia* originate at the base of the folds, immediately below the reproductive organs. Their origin thus constitutes an excellent mark to indicate the base of the column. This enables us to assert that in *Adamsia* the foot is all

that part of the animal which secretes the parchment-like mucus, although this part is not entirely attached, as in *Sagartia parasitica*.

The deformation undergone by the animal is due to the considerable expansion of this foot, carrying with it the lower part of the column. This expansion becomes so great in the completely developed animal that the foot and the wall of the column become to a great extent parallel. From this results the remarkable fact that true gastric canals are formed by the elongation of the folds in a horizontal direction.

The ovules before deposition are furnished with a germinal vesicle, which we do not find after their escape. Fecundation is therefore internal. Segmentation, which is very easily observed, takes place regularly up to sixteen cells. The *Morulæ* are all of very irregular form. They become transformed into *Gastrulæ*.

I have traced the further development to a *larval form* with eight tentacles, the form in which fixation takes place. I have also observed very small fixed *Adamsiæ* of hexameral type and not yet deformed. Others, a little older, showed various degrees of deformation. They show that the Actinia after attaining a certain size upon the inner margin of the aperture of a gasteropod shell, spreads out to the right and left, following exactly the outer margin of the shell, but without concealing it at all. We see therefore that the commencement of the deformation has as its result the sheltering of the hermit-crab. It is only later on and secondarily that the shell of the gasteropod is covered by the *Adamsia*.—*Comptes Rendus*, July 13, 1885, p. 173.

Note on "Deep-sea and Shallow-water Hydrozoa." By J. J. Quelch, B.Sc. (Lond.).

In the last Number of the 'Annals and Magazine of Natural History,' in a paper "On some Deep-sea and Shallow-water Hydrozoa," a new species of *Plumularia* was described by me under the name of *Plumularia delicatula*. It was quite overlooked by me at the time that this name had already been applied by Mr. Bale to an Australian *Plumularia* (Journ. Micr. Soc. Victoria, vol. ii.). For the Cape-Verde species, which is thus destitute of a name, I substitute the term "*annuligera*," suggested by the more or less ringed extremities of the internodes; so that the species should be known as *Plumularia annuligera*.

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THE ANNALS

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[FIFTH SERIES.]

No. 93. SEPTEMBER 1885.

XVII.—*On* Phœnicurus. By M. H. de Lacaze-Duthiers *.

While investigating *Tethys leporina* in the spring, at the Laboratoire Arago, I found in large quantities the curious parasite which that mollusk bears attached to its sides.

Upon *Phœnicurus*, which is the name of the parasite, we have only very imperfect information; but it was known to Rudolphi, Cuvier, and Delle Chiaje. This last naturalist, who at first thought he was the discoverer of it and called it *Planaria*, indicated how it is attached by its mouth to the mamillæ which are observed in the middle of the inter-branchial fossæ of the *Tethys*; he recognized in the interior of its body the numerous muscular bands which give it great contractility, as also the chief part of its digestive tube; but although he has given some good figures of the exterior of the animal his indications of its organization, when given, are very unsatisfactory.

A favourable opportunity having presented itself, the following are some of the facts which I have ascertained:—

The body of *Phœnicurus* has the form of a boy's kite; it

* Translated from the 'Comptes Rendus de l'Académie des Sciences, July 6, 1885, tome ci. pp. 30–35.

is flat, rounded at one of its extremities, and drawn out into a point at the other; sometimes this extremity is simple, sometimes furcate, but whether single or double it is coloured red, which justifies the name of *Phœnicurus*.

The two surfaces are very different. One, the most extended, is marked with large black and whitish spots, washed over with a general slight reddish tinge, which is very variable in different individuals; it reminds one of the colouring of the back of certain toads. The other, which is white, is less extended, and margined by the former, which borders it and forms a sort of raised pad all round it.

The rounded extremity of the body bears an oval pit, pierced in the centre by an orifice. The skin of this pit is fine, smooth, white, and nearly transparent; it is bounded by a pad formed by the extremities of the two surfaces, which differ in colour.

This is all that we observe in the exterior of the animal.

When the *Phœnicurus* is in a very lively state it is seen to contract and change its form incessantly; it twists and inflates itself on the side of the marbled surface, especially towards the rounded extremity, which is then inclined towards the whitish surface, and the body becomes bent. Thus one is led to regard the surface covered with the pattern as the back of the animal, and the white surface as the anterior or abdominal part.

Led away by this impression I first of all sought the nervous system by opening the *Phœnicurus* on the coloured surface, but I found nothing, and it was only by resuming the dissection from the opposite surface that I obtained any results and displayed the centres of innervation.

The most normally constituted nervous system that I have met with presents, as a centre, two ganglia, one left, the other right, united by a long transverse commissure. From each of these ganglia issue two principal nerves, a superior one going to the neighbourhood of the mouth, an inferior one descending towards the tail. These centres are distant from one another and nearly lateral; they are situated at the junction of the anterior third of the body with the inferior two thirds, and thus the four superior and inferior nerves, with the ganglia and the transverse commissure, form an H, of which the branches are of unequal size. These ganglia are small relatively to the size of the animal; they contain large and not numerous nerve-cells with peculiar characters, which will be referred to hereafter in the histological examination.

The numerous, transverse secondary nerves issue both from the ganglia and from the large principal nerves to run into

all parts of the organism. They are in general very slender, very long, and most frequently much undulated, a condition which is in relation to the movements of extension and contraction of the body. They are divided into two very constant orders. Not far from the ganglia are given off some large trunks, some of which run into the common tissue situated within the muscular layers, which will be referred to further on; while the others, traversing these layers, are distributed to the subcutaneous tissue and probably arrive at the skin. This, however, is difficult to make out by dissections or sections, and the discovery of these terminations will be purely a matter of chance.

Studied in a great number of individuals the nervous system presents peculiarities which merit notice. The two superior nerves are stout and terminate suddenly close to the buccal orifice. I shall have to revert to this termination. In their course they give off pretty numerous delicate branches which run into the subcutaneous tissue of the buccal pit.

The nerves, as they depart from the centre, present from point to point ganglionic inflations of very variable bulk and composed of one, two, or three elongated cells, the larger axis of which is parallel to their direction.

Another very remarkable peculiarity is the following:—I think I have never met with two individuals presenting a complete identity in the composition of the nervous centres. The following are some of the arrangements observed:—Sometimes there was only one median ganglion, from which issued the two large buccal nerves and the two principal nerves of the caudal extremity; sometimes I have only met with a sort of chain of three or four elongated ganglia placed one after the other, a single nerve running towards the mouth and another towards the tail. Lastly, in one case, I found seven small ganglia arranged transversely and united not only by a transverse commissure, but also by filaments forming a network, a true plexus. In all cases, whatever may be the number of the ganglia, the situation of the nervous system as a whole, with regard to the digestive tube and the muscles, continues the same, and the filaments are distributed in part to the middle of the body and in part to the subcutaneous layers.

Finally, it is not uncommon to find only a single buccal nerve, and in this case the nerve is stouter; and I have seen the two buccal nerves issue from the same ganglion.

To sum up, the position of the nervous system is constant, but its forms vary infinitely.

I have still to note this fact—I found a transverse cord

issuing from the buccal nerves and uniting them, passing in front of the digestive tube. Was this an œsophageal collar or a simple anastomosis?

Phœnicurus presents a very interesting histological constitution, which will form the subject of a separate memoir. I shall say but little about it at present. Its body has no general cavity, it is therefore *acœlomatous*; but it is filled up with a cellular-fibrillar tissue showing nuclei, in the midst of which and soldered to it are various organs and large cells or vesicles which are often visible to the naked eye, and may acquire enormous dimensions.

Under the skin, after a layer of connective tissue, we find long muscular bands regularly spaced and forming two laminæ, one dorsal, the other abdominal, passing to the buccal and caudal extremities. Between these two laminæ is the central part. The body is in this way divided into three zones, two external to the muscular bands and one intermediate. Further other fibres, also muscular, but transverse and exterior to the former, to which they are attached, crossing them at right angles, form a true trellis, which is easily discovered; for it appears very evidently so soon as one opens the body of the animal and removes the integuments. At the sides, to the right and left, there are also bundles of muscular fibres passing perpendicularly from one surface to the other, which assist in limiting the central space.

It is in this median intermuscular space that we find the digestive tube, the central nervous system, and a special gland, the only organs that I have been able to observe.

The digestive tube commences at the central orifice of the pit noticed towards the rounded extremity, and descends to the tail. Sometimes, after leaving the mouth, it presents a dilatation followed by a constriction, indicated by Delle Chiaje; but great importance must not be attached to this arrangement, which varies with the state of the individuals.

The tube, which is sometimes even, sometimes irregular, narrowed, or dilated, descends narrowing to the neighbourhood of the tail, and throughout its length, as in all directions, in front, behind, and on the sides, gives origin to branches, which ramify infinitely, traversing the muscular interstices, and extending by their delicate branches into the vicinity of the integuments. From this point of view *Phœnicurus* is a very characteristic *Dendrocœlan*.

The walls of the digestive tube, which are of extreme delicacy, easily escape observation if they are not filled with some coloured material or submitted to the action of some reagent which reveals their presence. I have not found any anus.

The last organ of which I was able to ascertain the existence is a very simple gland formed by a tube terminating in one or two cæca, and bearing some rare lateral cæca. One of them, directed towards the white surface of the body, but not extending to the integuments, is constant and larger. This gland is situated towards the marbled surface, and opens into the buccal orifice itself. What are its functions? It is difficult to say, although it seems natural to regard it as a salivary gland.

I have proved that what Delle Chiaje regarded in *Tethys* as an aquiferous apparatus was nothing but the venous apparatus of the mollusk, opening externally at the apex of the papilla situated in the centre of the interbranchial fossæ. The *Phœnicurus*, grasping this papilla with its mouth, can therefore at any moment suck in the sanguine fluid of the *Tethys*, of which it is the parasite in the most exact acceptation of the word.

From what has been stated it is now easy to place and orientate the animal. Placing the nervous system posteriorly, the white surface evidently represents the back, and the marbled surface is anterior; the mouth being placed above, all the positions are easy to characterize and indicate. Hence to find the nervous system we must open the *Phœnicurus* at the back, and remove the subcutaneous tissues, and it is in front of the muscular bands that we discover the ganglia; then it will be seen that in passing from back to front we find the nervous system, the digestive tube, and the salivary gland.

Phœnicurus appears to me to be very distinctly characterized as a *Dendrocœlan* by the absence of the abdominal ganglionic chain and by the arrangement of its arborescent intestine.

To fix more completely its zoological relations it would be of service to have traced its evolution. Now, in the month of May, I was unable to discover the organs of reproduction; only once I found an individual in which the large cells above mentioned had acquired enormous proportions. The skin of the animal being torn, they projected outwards like bunches of grapes. I will not assert that they represented ova, for all questions relating to reproduction remain to be cleared up. It is important that I should repeat that my observations were made in the month of May, and that, in the animals preserved, I have not met with reproductive organs, which are so easily recognized in the Turbellaria or the Trematoda.

Does *Phœnicurus* represent only a period or a stage of its whole existence? Is it a creature deformed or degraded by parasitism? Is its evolution accomplished under varied forms

in different stations? These questions are equally curious and interesting to solve.

I have had the *Phœnicurus* in abundance at the Laboratoire Arago. My boat, every time it went out to seek specimens of *Tethys* for me, brought me a great number of all sizes, free or fixed. I hope, therefore, shortly to elucidate this still obscure history.

XVIII.—*On the Relationship of* Ulodendron, *Lindley and Hutton, to* Lepidodendron, *Sternberg*; Bothrodendron, *Lindley and Hutton*; Sigillaria, *Brongniart*; *and* Rhytidodendron, *Boulay*. By Robert Kidston, F.G.S.

[Plates III.–VII.]

[Continued from page 139.]

II. Descriptions of Specimens.

Lepidodendron Veltheimianum, Sternberg.

Specimen No. 1. From Burghlee Pit, Loanhead, Midlothian (Carboniferous Limestone Series). Pl. III. fig. 1 (nat. size). —This fossil, which is represented by an *impression* of the plant in a fine-grained micaceous sandstone, is 15 inches long and at its broadest part about 4½ inches wide. Towards its upper part it shows one of the characteristic Ulodendroid scars, which is 4½ inches high and 2½ inches wide. The central umbilicus is situated about 2 inches above the lower margin of the scar. On the lower surface of the Ulodendroid scar, and extending slightly above and around its umbilicus, are rows of little "dots" arranged in spirals, converging towards the umbilicus. The little "dots" indicate the position of the vascular bundles of the aborted leaves, and become closer to each other as they approach the umbilicus. On the upper part of the scar is a number of straight lines which radiate from the umbilicus; these are the impressions of the basal leaves or bracts of the appendicular organ. The umbilicus is slightly raised. On other parts of the specimen are seen the impressions of the leaf-scars, which are, in form and arrangement, similar to those of *Lepidodendron Veltheimianum*. To the left of the fossil the leaf-scars are obliterated by a longitudinal splitting of the bark.

As the specimen is only an impression it must be remembered that the elevations on the fossil were depressions in the plant.

Specimen No. 2. From Straiton Oil Shales, near Edinburgh (Calciferous Sandstone Series).—This example is a fragment of what must have been a large stem. The specimen, which is an impression in very fine-grained bituminous oil shale, measures 9 inches in length by nearly 8 inches in breadth. Towards the centre are shown two Ulodendroid scars, about $1\frac{9}{10}$ inches long, by $1\frac{6}{10}$ inches broad, standing rather less than $1\frac{1}{2}$ inches apart. This example is chiefly interesting from the absence of the longitudinal fissures which are so characteristic of these Ulodendroid stems. As a consequence, from the increase in girth of the stem, the leaf-scars are much broader than in those examples where the bark is longitudinally fissured. This specimen shows a similar change in the lateral extension of the leaf-scars to that w ich occurs in the older stems of *Lepidodendra* which do not bear Ulodendroid scars. The leaf-scars on this fossil are very similar in general form to the figure of *Sagenaria Veltheimiana* given by Römer in 'Palæontographica,' vol. ix. pl. iii. fig. 6, only in the British specimen their breadth is greater in proportion to their length; they are, in fact, nearly as broad as long.

Specimen No. 3. From the Oil Shales, West Calder, Midlothian (Calciferous Sandstone Series).—Specimen in the collection of the Addiewell Oil Co., Addiewell. Pl. IV. fig. 2.—This figure shows a portion of a large stem of *Lepidodendron Veltheimianum*, 25 inches long and about 4 inches wide. The greater part of the fossil shows the outer surface of the stem, on which are exhibited, in a very early state of development, three Ulodendroid scars and a part of a fourth. The Ulodendroid scars, from centre to centre, are $5\frac{1}{2}$ inches apart. They are slightly elevated, and do not show a clearly defined umbilical nodule, having an appearance as if the appendicular organ had been forcibly removed. In this early condition of development of the Ulodendroid scar, the appendicular organ appears to have been attached at its upper margin. Another interesting point shown by this example is the presence of the ordinary leaf-scars on the Ulodendroid scar. These are a continuation of the ordinary series of the leaf-scars on the stem, and converge from all sides to the centre of the upper margin of the slight inflation. As there is here the outer surface of the stem, it is clearly shown that in the elementary condition the part bearing the appendicular organ stood at a slightly higher level than the rest of the bark. This inflation, however, eventually became effaced by the increase of the stem causing the bark to swell up around the base of the appendicular organ, and by this means the

originally slightly elevated cushion is converted into a circular or oval depression. The point of attachment of the appendicular organ in this example is in the centre of the upper margin. This point represents the umbilicus of the older scars. The part of the depression above the umbilicus on older stems is therefore entirely caused by the pressure of the base of the appendicular organ upon the bark.

The leaf-scars are elongated-rhomboidal, and slightly raised above the surface. Those of each series are connected with each other by a flexuous ridge. The vascular bundle dots are not shown, but the position of the vascular scar is indicated by a little ridge.

The bark at this age shows no traces of the longitudinal clefts which are so characteristic of older examples.

The full width of the stem at its lower portion is about 4 inches, and that this is its complete breadth is proved by the impression of one of the Ulodendroid scars of the corresponding opposite vertical row occurring in the matrix where part of the stem has been removed. The surface of the bark between the leaf-scars, at certain parts of the stem, is ornamented with fine ridges, though they are not present, or only feebly so, on the small portion which forms the subject of figure 2.

Specimen No. 4. From Dalmeny, Linlithgowshire (Calciferous Sandstone Series). Collected by Dr. Macfarlane. Pl. IV. fig. 3 (nat. size).—This specimen, which measures about 6 by $4\frac{1}{2}$ inches, is preserved in a very fine-grained bituminous oil shale. The leaf-scars are fusiform and slightly elevated, those of the same series being connected with each other by a slightly raised flexuous ridge. The surface of the bark between the leaf-scars is beautifully ornamented with fine, somewhat irregularly placed wavy lines. The vascular scar is not clearly shown, but appears as a slightly raised point towards the upper part of the leaf-scar. As the example only shows one of the outer margins of the stem, its original width cannot be ascertained.

Specimen No. 5. From West Calder, Midlothian (Calciferous Sandstone Series). Pl. IV. fig. 4 (nat. size).—This figure shows a small portion of an impression of a large stem, which is fully 2 feet long. The upper portion apparently represents the complete breadth of the stem, which is 7 inches across. The specimen shows no sign of any Ulodendroid scar. The leaf-scars are elongated-rhomboidal or fusiform, those in one series connected with each other by a ridge. The vascular scar is situated towards the upper part of the

leaf-scar, but its details of structure are not shown. The leaf-scars are almost contiguous, being only separated laterally from each other by the caudate extension, which runs from the apex of one scar to the base of another. The bark is much cleft by longitudinal fissures; a portion of one of these is shown in the figure. The matrix on which the impression has been stamped is a very fine bituminous oil shale.

This example also shows at certain parts the same character, though not so strongly carried out, as in the specimen of *Lepidodendron acuminatum* mentioned by Stur, Culm-Flora, p. 398, pl. xxii. (xxxix.) fig. 4, where the leaf-scars sometimes seem to lose their spiral arrangement, and appear to be placed in vertical rows, simulating somewhat in this peculiarity a *sigillarian* arrangement of leaf-scars.

Specimen No. 6. From Blackbraes, West Calder, Midlothian (Calciferous Sandstone Series). Collected by J. Linn, Esq. Pl. VI. fig. 11.—The specimen, shown in fig. 11 reduced to $\frac{1}{3}$ natural size, measures in its greatest length 7 inches, its width being about 4 inches. The fossil shows part of a stem, which must have been of considerable size. The small fragment of it that has been collected, still retains its rounded form, and seems to have suffered little from pressure. The matrix of this example is a fine-grained sandstone, and though the leaf-scars are not very well shown, at *a*, fig. 11, they are sufficiently well preserved to admit of a satisfactory specific determination. The Ulodendroid scar is almost circular, considerably depressed, and measures about $1\frac{1}{2}$ inches in diameter. The basal portion of the appendicular organ which fits into the scar has also fortunately been preserved. This is shown in profile at fig. 11 *b*, and a view of its basal aspect is seen at fig. 11 *c*; both of these figures are natural size. The outer surface of the fossil is discoloured by the carbonaceous matter of the plant. This is especially marked on the surface of the depressed Ulodendroid scar, and on the base of the appendicular organ, which, with the exception of a very small spot towards the centre of each, indicating the point of attachment of the appendicular organ, are stained dark brown. Had the appendicular organ been attached to the stem by the whole of its surface, its base and the surface of the Ulodendroid scar could not have been covered with carbonaceous matter. To the right of fig. 11 *c* are seen in the matrix what may possibly be the remains of leaves. In the profile, fig. 11 *b*, the markings on the outer surface of the appendicular organ have very much the appearance of leaf-scars, but cones, when the upward extending portion of their bracts is broken off, have also a resem-

blance to ordinary leaf-scars, as is well shown in Sir Joseph Hooker's plates of *Lepidostrobi* *. This specimen, therefore, does not, unfortunately, help us to decide whether stalked or sessile cones were attached to the Ulodendroid scars.

At fig. 11 *a* is shown, natural size, the small portion of the stem marked *a*, fig. 11. This part is at a slightly lower level than the rest of the outer surface of the fossil, and the leaf-scars are slightly larger; it is therefore probable that this fragment of the specimen is not in its true position.

This example shows no traces of longitudinal clefts in the bark.

Specimen No. 7. From Addiewell, Midlothian (Calciferous Sandstone Series). Collected by Dr. Macfarlane.—This example, which is about 4 inches high and $4\frac{1}{2}$ inches wide, shows towards the left side of the fossil a Ulodendroid scar. This is oval, and measures across the umbilicus about $\frac{7}{10}$ of an inch. Its upper border is clearly defined, but the lower portion of the scar, from the umbilicus downward, gradually assumes the appearance of the ordinary leaf-scar-covered bark, being clearly covered with broadly-fusiform leaf-scars, similar in shape to those occurring on other parts of the stem and belonging to the same spiral series. The leaf-scars on the upper part of the Ulodendroid scar are, however, obliterated.

Specimen No. 8. From Todholes, on the Bannoch-Burn, about 5 miles S.W. of Stirling (Carboniferous Limestone Series).—This specimen is the impression of a portion of an old and much-cleft stem. The fossil measures about 11 inches in length and 8 in breadth. The main interest of this example lies in the numerous ridges (the casts of the clefts in the bark) which occur on its surface. Evidently these ridges originally stood up at right angles to the surface of the impression, but have been flattened or bent over by subsequent pressure, and now hide the leaf-scars beneath their extended surface. Some of these ridges have at different parts of the fossil been broken off, and show that their line of attachment to the fossil is comparatively small in proportion to the superficial area they now in their flattened condition present. As an instance, the width of one of these ridges measures fully $\frac{8}{10}$ of an inch, but where it is broken off, the line which represents the original width of the cleft, and on which no leaf-scars are seen, only measures $\frac{4}{10}$ of an inch; the remaining $\frac{4}{10}$ inch of the flattened ridge is simply superin-

* Memoirs of the Geol. Survey of Great Britain, vol. ii. pt. ii. p. 440, pls. iv., vii., & viii., 1848. (Remarks on the Structure and Affinities of some *Lepidostrobi*.)

cumbent on the surface of the stem, and hides beneath it the impressions of the ordinary leaf-scars.

As these ridges are often more a bending over to one side than a flattening out of the ridge, probably the surface they now present represents the original depth of the clefts in the bark; if this view is correct, in this case they cannot have been much less than an inch deep. The form of the leaf-scars is broadly fusiform, and they agree well in character with those of *Sagenaria* (*Lepidodendron*) *acuminata*, Göppert*.

Specimen No. 9. From same locality as No. 8.—On another impression, which is about 6 inches high and 10 inches broad, the flattening of the casts of the clefts in the bark is carried to a greater extent than in the last specimen. Over a space of about $5\frac{1}{2}$ inches, the whole of the leaf-scars are obliterated by the flattening of what appear to have been 7 ridges (the casts of what were originally 7 clefts in the bark). This is succeeded by a vertical band of about 1 inch wide, on which the impressions of the leaves are shown; succeeding this there is another ridge about $\frac{6}{10}$ of an inch wide, then another vertical band exhibiting the leaf-scars $1\frac{1}{2}$ inch wide, then another flattened ridge fully an inch wide. Impressions of *Lepidodendron Veltheimianum*, on which the leaf-scars are quite obliterated by these flattened ridges, have been handed to me several times as Sigillarian stems.

Specimen No. 10. *Lepidodendron* (*Veltheimianum* ?). From Grange Colliery, Bo'ness, Linlithgowshire (Carboniferous Limestone Series). Collected by H. M. Cadell, Esq.—This specimen occurred along with numerous examples of *Lepidodendron Veltheimianum*; but as none of the leaf-scars are seen on the fossil, it would be unsafe positively to refer it to that species. It represents the impression of a fragment of a very old stem, from which all traces of the leaf-scars have been obliterated by longitudinal furrows; these have rounded surfaces, and do not run continuously for any great length, but as soon as one ceases, another originates to take its place. It appears to have been a similar condition of an old Lepidodendroid stem that has given rise to the *Lyginodendron Landsburgii*, Gourlie †. A somewhat similar state of an old stem of *Lepidodendron* has been figured by Sir William Dawson‡. Probably the Bo'ness example only represents a further stage of the

* Foss. Flora d. Uebergangsgebirges, pl. xxiii. fig. 4, and pl. xliii. fig. 8.

† Proceed. of Phil. Soc. of Glasgow, vol. i. pt. ii. p. 108 (1841–44). I am doubtful if the plant whose curious structure has been so fully explained by Dr. Williamson as *Lyginodendron Oldhamii* has any connexion with the genus *Lyginodendron* of Gourlie.

‡ Acadian Geol. 2nd ed. p. 445, fig. 170 *c* (1868).

longitudinal fissuring of the bark mentioned as occurring in the last described specimen of *Lepidodendron Veltheimianum.*

Specimen No. 11. Small branches and stems of *Lepidodendron Veltheimianum*, in a beautiful state of preservation, with the leaf-scars similar to that figured by Göppert in his Foss. Flora d. Uebergangsgebirges, pl. xxiii. figs. 1–3, are extremely abundant at many localities in the Calciferous Sandstone Series in the neighbourhood of Edinburgh. There also occur frequently examples with leaf-scars which agree in character with those named *Lepidodendron* (*Sagenaria*) *elliptica* by Göppert * (Pl. IV. fig. 4). This is a common form of *Lepidodendron Veltheimianum* in Scotland.

Sigillaria discophora, König, sp.

Specimen No. 12. From Devonside, Tillicoultry, Clackmannanshire (Coal Measures). Collected by Mr. T. Mitchell. Pl. VII. fig. 12 (nat. size).

This example is preserved in a fine-grained micaceous sandstone, and is the *impression* of the plant. The outer layer of the bark is converted into a bright coaly matter, which has adhered to the matrix; hence the fossil shows the *inner surface of the outer cortical layer.* Towards the left is seen a portion of a Ulodendroid scar, on whose surface are exhibited in series, which evidently converge towards the umbilicus, several rows of elevated little dots that mark the position of the vascular bundles of the aborted leaves. The remainder of the fossil is covered by the leaf-scars, which vary much in size and shape. At *a*, fig. 12, they are very small, some only measuring about $\frac{1}{6}$ of an inch in their transverse diameter; their upper and lower angles are rounded, the lateral angles sharp and prominent. The vascular-bundle scar is slightly above the centre.

On the greater portion of the specimen the leaf-scars are rhomboidal, the boundary-line of the leaf-scar being slightly raised. The position of the vascular bundle is usually indicated by a small tubercle, but sometimes this appears to be double. On none of the leaf-scars are the vascular-bundle impressions clearly seen.

Remains of the foliage are indicated at several points at the margin of the specimen. The leaves appear to have been very narrow and long, and are single-nerved. Their complete length is not shown, all of the leaves being imperfectly preserved. Figs. 12 *a* and 12 *b* show a few of the leaf-scars enlarged, to illustrate their variation in form on the same

* Göppert, *l. c.* pl. xliii. fig. 7.

example. These two figures correspond to the parts lettered *a* and *b* on fig. 12.

Specimen No. 13. Locality: "Coal Measures, British." Specimen in the collection of the Geological Survey of Great Britain, Museum of Practical Geology, Jermyn Street, London. Pl. V. fig. 8 (nat. size).—This is one of the most beautiful specimens of *Sigillaria discophora*, König, sp., that I have seen. It is about $3\frac{1}{2}$ inches square. Towards the right there are two Ulodendroid scars, from the umbilicus of which very slightly elevated ridges radiate on all sides. A small part of the outer cortical layer has been removed, but on the portion which shows the outer surface of the stem the leaf-scars are well preserved. Their transverse diameter is slightly greater than their vertical height; the upper and lower angles are rounded, and the lateral angles prominent. The scar of the vascular bundle is situated towards the upper part of the leaf-scar, and slightly above the centre.

Where the outer layer of the bark has been removed, the inner surface exhibits delicate markings, among which are conspicuous the little elevated "dots" that mark the position of the passages for the foliar vascular bundles. This latter condition of the stem forms the genus *Bothrodendron*, Lindley and Hutton. The two Ulodendroid scars have evidently almost touched each other; but this character is slightly obscured, on account of the lower edge of the upper Ulodendroid scar having been slightly broken.

My thanks are due to Dr. A. Geikie, Director-General of the Geological Survey of Great Britain, for kindly allowing me to figure and describe this interesting example.

Specimen No. 14. From Furnace Bank Pit, Old Sauchie, Clackmannanshire (Coal Measures). Pl. VII. fig. 13 ($\frac{1}{4}$ nat. size).—The specimen, the figure of which is a quarter natural size, measures fully 16 inches long by 11 inches broad. It is preserved in a fine-grained, purple micaceous sandstone. The fossil is an impression of what must have been a very large stem; adhering to its surface is part of the epidermal layer of the bark. Towards the right of the fossil are portions of two large Ulodendroid scars, whose vertical height is about $3\frac{1}{2}$ inches. Owing, in part, to the age of the specimen, and in part to its state of preservation, the leaf-scars assume, at some portions of the stem, an almost quadrangular form, and show at their centre a large rounded tubercle. Some such leaf-scars are shown, natural size, at fig. 13 *a*. On other parts of this specimen the *Bothrodendron* condition is exhibited. A small portion of the stem, showing this state, is represented, natural size, at fig. 13 *b*. Here there are ar-

ranged, in quincuncial order, rows of shallow elongated pits, the channels through which the foliar bundles passed to the leaves. The impression bears numerous longitudinal ridges, which are more or less interrupted during their course; they cease after extending some distance, when others spring up alongside of those which have terminated, and continue their course in the same direction. On the reduced sketch, fig. 13, the leaf-scars are rather too small.

Specimen No. 15. From the same locality as No. 14. Pl. IV. fig. 5 (nat. size).—This specimen is the *impression* of a small fragment of the outer surface of the bark, showing the rhomboidal leaf-scars. The upper and lower angle of the leaf-scar is rounded; the lateral angles are prominent. In the compressed state in which the fossil occurs the leaf-scars appear as if separated by an interval, but this interval is the impression of the slightly raised cushion on which the leaf-scar is situated. At the part marked *a*, fig. 5, the intervening space between the leaf-scars shows a central line, clearly indicating that it belongs in part to the two contiguous leaf-scars, and is, in fact, the now compressed cushion whose area slightly exceeded that of the leaf-scar which it bore. Fig. 5 *a* shows a few of the leaf-scars enlarged. The vascular-bundle scar is situated towards the upper part of the leaf-scar, and is only indicated in this example by a single "dot." Towards the centre and right hand of the specimen the bark is seen to be longitudinally split *.

Sigillaria Taylori, Carruthers, sp.

Specimen No. 16. From Camps Lime Quarry, Midcalder, Midlothian (Calciferous Sandstone Series). Collected by the late R. F. B. Hislop, Esq., Edinburgh. Pl. IV. fig. 6 (nat. size).

The greater portion of this specimen is badly preserved, and nothing further is shown on the fossil than that represented in fig. 6. Of the two Ulodendroid scars, the upper is much larger than the lower. On the upper part of both is seen a row of slightly elevated ridges arranged in a semicircle. These are evidently *casts* of the channels through which the vascular bundles passed to the aborted leaves.

The chief point of interest afforded by this example, which exhibits the true outer surface of the bark, is the beautifully preserved leaf-scars seen to the right of the lower Ulodendroid scar. A few of these are enlarged in fig. 6 *a*.

The leaf-scars are rhomboidal, slightly elevated, very small, being little more than one tenth of an inch in transverse diameter; their upper and lower angles are rounded, and their

* Figs. 5 and 5 *a* are drawn on the Plate in inverted position.

lateral angles sharp. The cushion on which they are placed very slightly exceeds the size of the leaf-scar. The vascular-bundle impression is situated a little above the centre of the leaf-scar.

Specimen No. 17. From the Oil Shales, Addiewell, Midlothian. In the collection of the Addiewell Oil Company (Calciferous Sandstone Series). Pl. VI. fig. 10, 10 *b*, *c*, *d* (fig. 10, $\frac{1}{3}$ nat. size; fig. 10 *b*, *c*, *d*, nat. size).

This specimen, which is preserved in a fine-grained bituminous oil-shale, exhibits the termination of a branch. It measures $15\frac{3}{4}$ inches in length and 4 inches in breadth. Very little of the fossil proper is preserved, the greater part of the example showing only the impression of the plant. The part marked *a*, fig. 10, is a small portion of the outer surface of the plant. That lettered *b*, *c*, *d* shows the *inner surface of the outer cortical layer*, and that marked *e*, *e* the impression of the outer surface of the stem in the matrix.

We must now enter more fully into the description of the various parts of this instructive specimen. On the small part of the fossil proper which is preserved (fig. 10 *a*) there is only a portion of one of the Ulodendroid scars shown; this occurs as a circular depression about $\frac{3}{4}$ inch wide. The opposite and corresponding row of Ulodendroid scars occurs on that part of the specimen lettered in the figure *b*, *c*, *d*. The epidermal layer of the bark has here adhered to the matrix, a circumstance which frequently takes place in this group of fossils, so that the view presented of this part is the *inner surface of the outer cortical layer*. On this are seen the casts of twelve Ulodendroid scars; and as they are looked at from the *inside* of the stem, they appear as elevations. In form and size they vary considerably. Many of them touch each other, but some are separated by a slight interval. A few are almost circular, whilst others are more or less elliptical; and occasionally, when two Ulodendroid scars come in contact, their sides become somewhat flattened from mutual pressure. The largest of these scars measures transversely $1\frac{1}{10}$ inch, the smallest about $\frac{7}{10}$ inch. The scar lettered *c*, fig. 10, is shown natural size at fig. 10 *c*. The whole of its surface is covered with little dots arranged in spirals, some belonging to series which do not converge towards the umbilicus, but go past it.

None of the Ulodendroid scars, of course, on the part lettered *b*, *c*, *d* show the straight or slightly bent bands on their upper part, which so commonly radiate from the umbilicus of Ulodendroid scars, as we are viewing the *inner* surface of the outer cortical layer; this also explains why the little "dots"

of the foliar bundles are exhibited so distinctly on their upper portions.

At *b*, fig. 10, the form of the leaf-scars is shown; these are represented natural size at fig. 10 *b*. This view likewise shows the *inner* surface of the outer cortical layer, and only gives a general idea of their form, which is rhomboidal. Slightly above the centre the channel through which the foliar vascular bundle has passed is indicated by a little "dot." At *d*, fig. 10, is exhibited the *Bothrodendron* condition of the fossil; this is represented natural size at fig. 10 *d*. Here all trace of the leaf-scar is obliterated, and nothing is left to indicate its position except the little "dots" which mark the channels of the foliar vascular bundles.

At *e*, fig. 10, is seen the impression of the outer surface of the stem. The form of the leaf-scars is not shown, as the specimen has been thickly covered with foliage; many of the leaves are seen extending past the margins and apex of the fossil.

This specimen is very interesting as exhibiting the termination of a branch, and is, so far as I know, the only specimen extant which shows that character.

Hugh Miller refers to a similar example, but, unfortunately, it has been lost *. The branch appears to have suddenly terminated in a truncated or obtuse apex, to the very summit of which were borne the Ulodendroid scars.

Specimen No. 18. From the bituminous Oil Shales (Calciferous Sandstone Series). Collected by Dr. Macfarlane. Pl. V. fig. 9 (nat. size).

The specimen, of which the sketch is natural size, is about 4 inches high by about the same wide. On the left of the plant are seen attached four of the *upward directed* appendicular organs. These, as well as the stem, are covered by foliage, but most of the leaves on the stem are broken off, and only their bases now remain attached to the leaf-scars.

The leaves or bracts on the appendicular organs are closely adpressed, and are best seen on that second from the base. The appendicular organs are in so young a state of development, that from any points they show it would be unsafe to state definitely whether they are sessile or stalked cones; but I incline to the former view. A portion of the fossil towards the lower part of the specimen has been removed, and on the matrix is seen the impression of one of the Ulodendroid scars of the opposite and corresponding row. From this we gather that the full width of the specimen could not have been much greater in its compressed state than 4 inches. The appendi-

* 'Testimony of the Rocks,' ed. 1857, pp. 462–464.

cular organs, which stand out in some relief, are about $\frac{3}{4}$ inch long and nearly as broad, and appear to have had rounded apices. The fourth and uppermost appendicular organ is not well shown, being partly covered with the matrix. From the presence of the foliage, the form of the leaf-scars cannot be seen.

Specimen No. 19. From the bituminous Oil Shales, Straiton, near Loanhead, Midlothian (Calciferous Sandstone Series).

This specimen is a portion of a branch about 1 foot long and 3 inches wide. It shows a vertical row of twelve Ulodendroid scars, and is mainly interesting as partly exhibiting the true outer surface of the stem, in which occur a few longitudinal clefts.

III. General Conclusions.

The point in which lies the essential generic difference between *Lepidodendron*, *Lepidophloios*, *Sigillaria*, and *Rhytidodendron* is the form and structure of the leaf-scar. My apology for referring to the generic characters of three such well-known genera as *Lepidodendron*, *Lepidophloios*, and *Sigillaria* is that their generic differences form the basis of my subsequent remarks. I am aware that, in addition to the structure of the leaf-scar, there are other points of minor importance which enter into the definitions of these genera; but as far as the subject which specially occupies our attention at present is concerned, we shall not require to enter more fully into the generic differences of the above-mentioned four genera other than those characters derived from the structure of the leaf-scar, the mode of the attachment of the leaf to the scar, and the cortical extension on which, in some cases, the leaf-scar is supported.

These four genera may be briefly defined as follows:—

Lepidodendron. (Pl. VII. fig. 15.)

Leaf-scars contiguous or distant, rhomboidal or fusiform, consisting of a "*field*" (*c*) and vascular-bundle scar (*a*), which is usually situated towards the upper part of the field. The vascular-bundle scar is transversely rhomboidal, its upper and lower angles rounded, the lateral angles more or less prominent. Vascular-bundle cicatricules *three, punctiform* (*b*). Immediately beneath the vascular-bundle scar are two small oval pits (*d*), one placed on each side of the median line (*f*). Above the vascular scar and on the medial line is the "ligule" depression (*e*). *Leaf-base attached to the whole area of the leaf-scar* (*including the* "*field*").

LEPIDOPHLOIOS. (Pl. VII. fig. 14.)

Leaf-scars *unprovided with a field* and reduced to the vascular scar (*a*), which is placed at the *lower extremity of a downward-directed cortical cushion* (*g*); its upper and lower angles are rounded, the lateral angles prominent. Vascular-bundle cicatricules *three, punctiform, the central one sometimes triangular.* On the cushion, above the leaf-scar, there occurs in some species a small tubercle. *Leaf attached to the vascular scar only.* Cushions to which the leaves are attached imbricated.

SIGILLARIA. (Pl. IV. fig. 7.)

Leaf-scars *unprovided with a "field,"* and reduced to the vascular scar. Stems smooth or furrowed.

(A) *Stem smooth.*—Leaf-scars distant (*Liodermariæ*) or contiguous (*Clathrariæ*, fig. 7), and placed in more or less elevated cushions.

(B) *Stems furrowed.*—Leaf-scars in vertical series, distant or contiguous (*Rhytidolepis*).

(In A & B.) Vascular scar more or less rhomboidal; upper and lower angles rounded; lateral angles prominent. Vascular-bundle cicatricules *three, central punctiform or more or less transversely elongated; the two lateral lunate or linear. Leaf-attachment restricted to the area of the vascular scar.*

RHYTIDODENDRON, Boulay.

(*Bothrodendron*, Zeiller, not Lindley and Hutton.)

Leaf-scars *unprovided with a "field,"* distant, and reduced to a vascular scar, which is *transversely oval or quadrate, with rounded angles*, very small, in the two described species * not $\frac{1}{10}$ inch in diameter. Vascular-bundle cicatricules *three, punctiform.*

As the form of the leaf varies among the species of a given genus, being in *Lepidodendron* and *Sigillaria* either long and grass-like or short and lanceolate, its shape only becomes a specific character.

The fructification of these plants is still imperfectly

* *Rhytidodendron minutifolium*, Boulay, and *R. punctatum*, Zeiller, sp. The former species I have seen from two localities in the Scotch Coal Measures—from débris at Kellybank Pit, Dollar, Clackmannanshire, and also from Bonnington Pit, Kilmarnock, Ayrshire (in the collection of Rev. D. Landsborough, Kilmarnock).

The plant I place here as *R. punctatum*, Zeiller, sp., was described by that botanist as *Bothrodendron punctatum*, L. & H. See Ann. d. Scienc. Nat. 6ᵉ sér., Bot. tome xiii. p. 218, pl. ix. figs. 1–3; also Végét. foss. du terr. houil. p. 116.

known. In *Lepidodendron* and *Sigillaria* * it consisted of cones, and in *Rhytidodendron* it was probably of a similar nature. In certain *Sigillariæ* and *Rhytidodendra* (*R. punctatum*) there is also occasionally a small tubercle above the leaf-scar or on some other part of the back (*Sig. spinulosa*, Germar)†.

The evidence afforded by the various specimens which have been described in the earlier part of this communication, as well as that derivable from examples figured and described by previous writers on this subject, may now be summarized, when I hope to show that plants not only belonging to *Lepidodendron*, but also to *Sigillaria* and *Rhytidodendron*, possess large scars, arranged on their stems in two opposite vertical rows.

Lepidodendron Veltheimianum, Sternberg.

It has been stated by some authors (Brongniart, Schimper, and others) that the leaf-scars on the stems of *Ulodendron* were always smaller than those occurring on the stems of *Lepidodendron* of a similar size, and also that the vertical clefts which occur in the bark of *Ulodendron* were not common to *Lepidodendron*. This may be a general rule, but it is by no means a universal one. The size of the leaf-scars on those so-called *Ulodendra* is very much influenced by the extent to which the bark has become longitudinally fissured, for these clefts act as escapements to the lateral strain (if not produced by it), which is caused by the increase in girth of the stem; whilst in those cases where the bark does not become fissured, the leaf-scars are laterally expanded by the same strain which produces the fissuring of the bark.

On specimen No. 1, Pl. III. fig. 1, it will be seen that the leaf-scars have attained a considerable size, and they cannot be said to be characteristically smaller than those of ordinary *Lepidodendra*, nor do they in any point differ in shape or arrangement from characteristic leaf-scars of *Lepidodendron Veltheimianum*. It is also to be noted that in this example the bark is more than usually free from the vertical fissures

* See Zeiller, "Sur des Cônes de Fructification des Sigillaires" ('Comptes Rendus des Séances de l'Académie des Sciences,' 30 June, 1884); also "Cônes de Fructification des Sigillaires" (Ann. des Scienc. Nat. 6e sér., Bot. tome xix. p. 256, pls. xi., xii.).

† I have not entered into the differences in internal structure between *Lepidodendron*, *Sigillaria*, and *Ulodendron*. Suffice it to say, that the internal organization of *Lepidodendron* and *Sigillaria* is distinctly different, and that the few specimens of *Ulodendron* which have been found with their internal structure preserved apparently agree with *Lepidodendron*.

which so frequently occur on large Ulodendroid stems. The leaf-scars on this fossil are, however, larger than they usually are on most Ulodendroid specimens, such as those figured by Brongniart *, Allan †, Stur ‡, and Schimper §. When the leaf-scars are small they are usually more or less distant (specimen No. 3, Pl. IV. fig. 2) ; but with their increase in size, the intervening space becomes gradually reduced till the leaf-scars are contiguous (fig. 1, Pl. III.) or nearly so, as in Stur's pl. xxii. fig. 3 *b*.

The leaf-scars appear to have been somewhat elevated; hence, when impressions of the plant are examined, the spaces intervening between the leaf-scars naturally appear as ridges running between them. These ridges, when partially flattened over the edges of the leaf-scars by pressure, thus somewhat obscure their upper and lower extremities as well as the margins of the leaf-scars generally, and cause the vascular impression to appear as if situated at the extreme upper angle of the leaf-scar ‖. It is this state of the plant that has given rise to the supposed "*Lepidophloios*-condition" of *Lepidodendron Veltheimianum* ¶.

The Ulodendroid scars, in their earlier condition, are also covered with leaf-scars belonging to the ordinary spiral series of the stem (see specimens Nos. 3 and 7).

In some cases the bark is quite free from longitudinal fissures, as mentioned in the description of specimen No. 2, where from lateral pressure exerted on the leaf-scars by the increase in girth of the stem, they are almost rhomboidal. In Pl. IV. fig. 2 is shown a small portion of the outer surface of a Ulodendroid specimen. The leaf-scars are distant, and connected with each other by a narrow flexuous ridge. This is more fully described in the notes on specimen No. 3, from which the figure is taken. In fig. 3, Pl. IV. (specimen No. 4) this character is more marked. In fig. 4, Pl. IV. is shown a very common form of leaf-scar, occurring both on specimens showing the large Ulodendroid scars and also on those on which they are not present, as was

* Hist. d. végét. foss. vol. ii. pl. xviii.

† Trans. Roy. Soc. Edin. vol. ix. pl. xiv.

‡ Culm-Flora, pl. xxii. (xxxix.) fig. 3.

§ Traité d. paléont. végét. pl. lxiii.

‖ Probably, in attempting to reconcile a *Lepidophloios* condition of *Lepidodendron* with *Lepidophloios*, Renault has been entrapped into producing a copy of Goldenberg's figure 6, pl. xvi., on his pl ix. fig. 1, with the vascular scar at the upper end of the cushion, whereas it should have been at its lower extremity.

¶ See Renault, Cours d. botan. foss. deuxième année, p. 10, pl. v. fig. 1.

the case with the example from which this sketch was made. This figure illustrates the form of the leaf-scar to which Göppert applied the name of *Lepidodendron* (*Sagenaria*) *ellipticum* *.

The fissures in the bark do not appear to have ever become filled with a subsequent development of tissue, but to have remained as open gashes, for of the numerous *impressions* of these plants which have come under my notice, in every case these clefts were represented as *elevated ridges* on the surface of the impression, or as *fissures* in the bark; hence they must have been open clefts at the time of mineralization. Nor do these clefts appear to have been caused by shrinkage or breakage of the bark after the plant was imbedded in the material which now forms its matrix; for had it been brought about by any secondary cause, we should expect to find these clefts in the bark of all *Lepidodendra*, which we do not.

But, on the other hand, all Lepidodendroid *Ulodendra* do not show this peculiar character of the bark becoming split, for I have seen specimens, some of them very large, of a Lepidodendroid *Ulodendron* from the Scotch Coal-Measures †, in whose bark, in only one case, was there a slight and indistinct indication of these vertical clefts. Therefore, although perhaps of specific value, I am not inclined to regard the longitudinal fissuring of the bark as of generic importance.

From many specimens of these so-called *Ulodendra* (*Ulodendron parmatum*, Carr.=*U. commutatum*, Schimper, &c.), some of which I figure (figs. 1–2), portions of the stems had been broken off, either from the sides of the fossils or from between the scars; such pieces could not have been distinguished from *Lepidodendron Veltheimianum*, Sternberg, with which they entirely agree.

Sigillaria discophora, König, sp.

I have given on Pl. IV. fig. 7, a copy of a few leaf-scars of *Sigillaria Brardii* ‡, for comparison with those of this and the following species.

The leaf-scars (*a*, fig. 7) of *Sigillaria Brardii* are placed on more or less elevated cushions (*g*, fig. 7). These cushions, as in *Lepidophloios*, are morphologically distinct from the leaf-structure, and belong to the cortical envelope, being portions of it, in fact, only mamilliform protuberances. Superficially

* Foss. Flora d. Uebergangsgebirges, pl. xliii. fig. 7.

† From Rosewell Colliery, Midlothian, and Bonnington Pit, Kilmarnock, Ayrshire.

‡ From Brongniart's Hist. d. végét. foss. pl. clviii. fig. 4.

these cushions more or less exceed in area the surface to which the leaf is articulated, and have a casual resemblance to the "field" in *Lepidodendron*, but with this they have no real relation. In *Lepidodendron* the leaf-base is attached to the "field" (*c*, fig. 15) as well as to the vascular scar; in *Sigillaria*, on the other hand, it is only attached to the vascular scar.

I now hope to show that in *Sigillaria discophora*, König sp. (= *U. majus*, L. & H., and *U. minus*, L. & H.), and *Ulodendron Taylori*, Carruthers, the leaf-scar agrees in all essential points with those of the Clathrarian *Sigillariæ*, of which I have taken *Sigillaria Brardii*, Brongniart, as the type. In fig. 12, Pl. VII. (specimen No. 12), a great diversity is seen in the form of the leaf-scar. Immediately beneath the Ulodendroid scar the leaf-scars are of the *Sigillaria-Brardii* type. These are enlarged in fig. 12 *a*, Pl. VII. They are rhomboidal, their upper and lower angles rounded, and their lateral angles produced and prominent; the leaf-scars are also placed upon slightly elevated cushions, and though the cushion is not much larger than the vascular scar, its presence is clearly observable. The small cushions on which the leaf-scars sit are well seen in Pl. V. fig. 8. This, I think, proves the structural identity of the leaf-scar of *Sigillaria discophora*, König, sp. (= *Ulodendron majus*, L. & H.), with that of the Clathrarian group of the genus *Sigillaria*.

I have not met with any specimens of *Sigillaria discophora* which clearly show the vascular-bundle cicatricules; but such have been figured by Sir William Dawson under the name of *Lepidophloios parvus**, where they are represented as of the ordinary Sigillarian type, with three vascular-bundle "dots," the central punctiform and the two lateral lunate. At the part marked *b*, fig. 12, Pl. VII. (specimen No. 12), and enlarged at fig. 12 *b*, the scars assume a quadrangular form and usually show a central "dot." Fig. 13 *a*, Pl. VII., gives a few leaf-scars, natural size, from fig. 13 (specimen No. 14). This form of leaf-scar, arising from the age of the specimen, and perhaps also from changes which have taken place during mineralization, has given rise to Dawson's *Lepidophloios tetragonus* †. The fact of this form of leaf-scar occurring on the specimen represented in fig. 12, Pl. VII., along with the ordinary leaf-scars of the species, proves conclusively the identity of *Lepidophloios tetragonus*, Dawson, with *Sigillaria discophora*, König, sp. On some specimens of this species, especially the older and larger ones, the bark also becomes

* Acadian Geol. 2nd ed. p. 455, fig. 170 G 3.

† *L. c.* p. 455, fig. 170 D.

fissured as in *Lepidodendron Veltheimianum*; this is seen in the fossils illustrated in figs. 5 & 13, Pls. IV. and VII.

Sigillaria Taylori, Carruthers, sp.

In form the leaf-scars in this species are essentially of the same type as those occurring in *Sigillaria discophora*, König, sp. They are small and seldom occur in so good a state of preservation as to give a clear idea of their form. I have, however, succeeded in securing several examples which afford the necessary details on this point. In fig. 6, Pl. IV. (specimen No. 16), the form of the leaf-scars is well seen. It is remarkable that on one small part of this fossil they should be so well preserved, and on all the rest of its surface be completely effaced. The upper and larger Ulodendroid scar appears to have been displaced.

The leaves of this and the previous species seem to have remained attached to the stem for a considerable time, and very often their being buried in the matrix appears to have given the outer layer of the bark a tendency to adhere to the impression side of the slab when the stones were split; when this happens there is presented to our view the form of the leaf-scars as seen on the *inner surface of the outer layer of the bark.* This condition is exhibited at the part marked *b*, fig. 10, Pl. VI., which is shown of the natural size in fig. 10 *b*. Fig. 12, Pl. VII., shows a like state of preservation.

At various parts of the specimens of *Sigillaria discophora* and *Sigillaria Taylori* are shown their decorticated conditions, for which Lindley and Hutton founded the genus *Bothrodendron* (Pl. VII. fig. 13 *b*, and Pl. VI. fig. 10 *d*).

[To be continued.]

XIX.—*On a Variety of the Freshwater Sponge* Meyenia fluviatilis, *auctt., from Florida.* By H. J. Carter, F.R.S. &c.

Next to Mr. Ed. Potts, of Philadelphia, comes Mr. Henry Mills, of Buffalo, in the discovery of freshwater sponges in his particular locality, and in the praiseworthy desire to advance the subject by sending specimens of them to European as well as American naturalists. Of the species in the Niagara River Mr. Mills has long since forwarded to me

several handsome specimens for distribution among the museums in this country, and proposes to send more; hence I have already been able to enrich the collections of *Spongillæ* in the British and Liverpool Museums respectively to this extent.

Not confining his researches to the Niagara River, Mr. Mills has also not forgotten the subject when abroad, although engaged in other matters probably of more importance, so that during his last two visits to Florida he has been almost equally successful there in his discovery of the freshwater sponges, and equally generous in sending about specimens of them on his return to Buffalo. One of them, which he has kindly sent to me, he has, at my suggestion, designated a variety of *Meyenia fluviatilis*, under the name of "*gracilis*," and this, from his accompanying data, together with two slides and a bit of the sponge itself in spirit, I shall, at his request, presently describe for publication; the rest, including his *Meyenia Everetti*, from Massachusetts, will probably appear in Mr. Potts's forthcoming Monograph of the freshwater sponges of North America.

Meyenia fluviatilis, var. *gracilis*.

Delicate in structure, which is soft, whitish or colourless in spirit, presenting the aspect of glue or sarcode when dry; growing over the stem of an aquatic plant in a thin layer charged beneath with statoblasts (gemmules). Spicules of two forms, viz.:—1, skeletal, very fine and delicate, acerate, curved, cylindrical, about 34 to 36 by $\frac{1}{2}$-6000th inch in its greatest dimensions, chiefly confined to the fibre; 2, statoblast-spicule, shaft long, cylindrical, often slightly curved, smooth, also very thin and delicate; head small, flat, radiately denticulated, the ends of the rays not recurved; often umbonated by a projecting spine or process, total length about 7-6000ths inch, head $1\frac{1}{2}$-6000ths inch in diameter, shaft about five times longer than the diameter of the head, about $\frac{1}{4}$-6000th inch thick; chiefly confined to the statoblast, but also loose and numerous in the tissue generally. Statoblast globular when wet, hemispherical and depressed in the direction of the aperture when dry; when fully formed about 65 to 75-6000ths inch in diameter. Aperture slightly marginated, *i. e.* slightly raised above the common level, about 8-6000ths inch in diameter. Surface of statoblast rough or uneven. In a section through the centre the crust is seen to be a little thicker than the length of the birotules, which, as usual, are arranged perpendicularly to the yellow chitinous coat beneath and parallel to each other, with one head resting

on the chitinous coat and the surface of the other free at the circumference; cemented together and held in position by the microcell-structure or "float," which, projecting above the level of the outer heads of the birotules, gives rise to the roughened state of the surface of the statoblast. Chitinous coat and germinal contents the same as in the Spongillæ generally. Size of specimen sent to me about $\frac{1}{4} \times \frac{1}{4}$ inch horizontally.

Hab. Fresh water.

Loc. "Ice-Factory Lakes, De Land, Florida, near the St. John's River."

Obs. The extremely delicate character of the spiculation generally, the microspined skeletal spicules, the great length of the birotules, and the radiating portions of the head being horizontal and *not* recurved at their extremities, allies this species more to *Meyenia fluviatilis* than to the *Heteromeyeniæ* (e. gr., *Spongilla Baileyi*, Bk., Proc. Zool. Soc. 1863, pl. xxxviii. fig. 6) of Mr. Potts. Hence the name.

XX.—*Diagnoses of new Species of Cephalopoda collected during the Cruise of H.M.S. 'Challenger.'*—Part II. *The Decapoda.* By William E. Hoyle, M.A. (Oxon), M.R.C.S., F.R.S.E., Naturalist to the 'Challenger' Commission.

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Myopsidæ.

Promachoteuthis, Hoyle.

Promachoteuthis, Hoyle, 1885, Narr. Chall. Exp. vol. i. p. 273, fig. 109.

The *Body* is short, rounded, with large broad *fins*, situated posteriorly. The *mantle* is free behind, as in *Rossia*. The *siphon* is short and slender and with everted margin; valve?

The *Head* is small and narrow; *eyes* not prominent.

The *Arms* are long and conical, with two series of pedunculate spherical *suckers*. The *tentacles* exactly resemble the arms at their origin; the club is absent.

The *Gladius* has not been removed from the single example.

Promachoteuthis megaptera, Hoyle (*loc. cit.*).

The *Body* is short, barrel-shaped, rounded behind; the *fin* is large, transversely elliptical, and extending beyond the end of the body posteriorly; each half is wider than long. The *mantle-margin* is transversely truncated. The *mantle-connective* consists of a linear ridge on either side, fitting into an almond-shaped depression at either side of the base of the *siphon*, which is short, slender, and has the distal margin everted, like the neck of a flask; the specimen was so small and indifferently preserved that it was not opened to ascertain whether a valve was present.

The *Head* is very small and narrow, almost the whole of its sides being occupied by the *eyes*, which are not prominent, but covered with a transparent membrane, and with a distinct pore in front of and below each.

The *Arms* are unequal, the fourth being the shortest (considerably so on the right side); the first, second, and third are subequal; they are on an average about the same length as the body, smoothly conical, and tapering evenly to fine points. The *suckers* are in two series throughout, pedunculate, spherical, with a lateral aperture directed inwards; the *horny ring* is smooth and surrounded by a few large papillæ. The *hectocotylus* is not developed. There is no trace of an *umbrella*. The *buccal membrane* is well developed and has the usual seven points, but they are not very well marked or provided with suckers; the membrane is not connected with the arms by ligaments. There seems to be only one *lip*, which is thick and papillate.

The *Tentacles* arise directly between the third and fourth arms, exactly resembling them at their origin, and obviously being part of one series with them; the *stem* is swollen at first and somewhat more than one third up the arms narrows rather suddenly to about half its previous diameter. The *club* is wanting.

The *Surface* is smooth.

The *Colour* is a dull purplish madder, paler on the fins (especially their under surface) and on the arms and tentacles.

The *Gladius* has not been extracted.

Hab. North Pacific, east of Japan (Station 237), 1875 fathoms. One specimen, sex?

LOLIGO, Lamarck.

Loligo ellipsura, n. sp.

The *Body* is elongated, widest anteriorly, and tapering

gradually to an acute point behind. The *fin* is comparatively short, only one third the length of the body, elliptical, slightly broader than long. The *mantle-margin* passes almost straight across the back, except where a long narrow median process juts out over the head; it is slightly sinuate ventrally. The *siphon* is short and blunt.

The *Head* is short and very nearly as broad as the body; it has the usual auricular crest and pre-ocular pore.

The *Arms* are unequal, the order of length being 3, 4, 2, 1, and about one third the length of the body; the first has a distinct web on its dorso-median angle, and the third a still broader web on its outer aspect, passing back nearly as far as the eye, where it becomes connected with another passing up the dorso-lateral aspect of the fourth. The *suckers* are in two series, pedunculate, oblique, notched distally, and somewhat larger on the lateral than on the other arms. The *horny rings* bear from five to seven large pointed teeth in their distal portion, but are smooth proximally. The *hectocotylus* is not present. The *buccal membrane* has the usual seven points, each of which carries two or three small suckers. The *outer lip* is thick and marked with radial grooves; the *inner lip* was not seen.

The *Tentacle* is slender, approximately cylindrical, and about two thirds the length of the body; its terminal fourth is occupied by the *club*, which is but little expanded, and has a delicate protective membrane along either side of the inner surface and a well-marked web externally. The large median *suckers* are about ten in number, and about twice as large as the alternating lateral; the proximal are about twenty, and gradually increasing; the distal occupy nearly one half the club, and are in four series diminishing. The *horny rings* of the largest suckers have about twenty-four distant square pointed teeth, much longer on the distal margin; the lateral ones have about half as many similar teeth on the outer margin, and the terminal suckers are armed in the same way.

The *Surface* has been almost entirely denuded of skin.

The *Colour* appears to have been pale buff with purple chromatophores.

The *Gladius* has not been extracted.

Hab. Off Sandy Point, South America (Station 313), 55 fathoms. One specimen, apparently ♀.

Loligo galatheæ, Steenstrup, MS.

The *Body* is about three times as long as broad, cylindrical anteriorly, and pointed behind. The *fin* is rather less than

half the length of the body *, about as long as broad, and with rounded lateral angles. The *mantle-margin* curves out rapidly to a triangular process in the dorsal median line, for the rest is almost transverse, except where it forms two obtuse-angled processes, one at either side of the ventral margination.

The *Head* is comparatively broad and with prominent rounded *eyes*. The *siphon* is moderately large and of the usual form.

The *Arms* are unequal, the order of length being 3, 4, 2, 1, and not quite one third as long as the body. The dorsal have a distinct keel on the upper margin, the second are keeled on the ventro-lateral aspect, the third are stout and flattened and have a broad web on the outer aspect, which unites with the web running up the dorso-lateral aspect of the ventral arms. The *suckers* are in two series throughout, with short peduncles, and not very oblique; their horny rings bear nearly twenty distant blunt teeth. The *hectocotylus* is not developed. The *umbrella* is absent. The *buccal membrane* has the usual seven points, each of which bears a few suckers. The *outer lip* is thin, the *inner* thin and papillate.

The *Tentacles* are comparatively short, being not quite so long as the body; the *stems* are subtriangular. The *club* occupies more than one third of the length, and has a protective membrane at either side of the suckers and a distinct web on the outer aspect. The large central *suckers* are from eight to ten in number, and nearly twice the diameter of the lateral ones; the proximal group consists of about ten, while the distal portion bears four series of diminishing suckers. The *horny ring* bears long, distant, bluntly pointed teeth, about twenty-four in the largest suckers, proportionally fewer in the smaller, which are much larger in the distal and external portions of the ring respectively.

The *Surface* is smooth.

The *Colour* is pale yellowish, spotted with brownish-purple and red chromatophores.

The *Gladius* has not been removed.

Hab. Philippine Islands (Station 203), 20 fathoms. Two specimens, juv.

Loligo kobiensis, n. sp.

The *Body* is elongated, cylindrical in the anterior moiety,

* With respect to this and one or two other points in the description it must be remembered that the specimens are immature.

then tapering posteriorly, and terminating in a blunt point. The *fin* is more than half the length of the body, trapezoidal, with rounded lateral angles; the extreme breadth is less than the length and is situated anteriorly to the middle of the fin. The *mantle-margin* presents a triangular process in the mid-dorsal line and is deeply sinuate ventrally. The *siphon* is short and bluntly conical.

The *Head* is short and not so broad as the body; the *eyes* are comparatively small and have a bracket-shaped auricular crest behind and a minute pore in front of them.

The *Arms* are unequal, the order of length being 3, 4, 2, 1, and, on the average, rather more than one third the length of the body; the first are the most slender, and have the dorso-median angle raised into a prominent keel; the second have only a faintly-marked angle ventro-laterally; the third have a broad web externally, passing over at the base into one which extends up the dorsal aspect of the lateral arms. The *suckers* are arranged in two series, pedunculate, very oblique, and rather larger on the lateral than on the other arms; the *horny ring* has about nine short, close-set, square-cut teeth on its distal side, and is smooth on the proximal. The *hectocotylus* was not observed. The *buccal membrane* has five points, each of which bears two or three small suckers; the two ventral points are rounded off; just within the ventral margin is a small papilla surrounded by two elevated rings, probably for the reception of spermatophores. Both the *outer* and *inner lips* are folded.

The *Tentacle* is faintly three-sided and shorter than the body, one third of its length being taken up by the *club*, which is expanded and triangular in section; there is a protective membrane on either side and a web externally; in the centre are eight large *suckers*, three times the diameter of the lateral ones; at the proximal end are about nine suckers, gradually increasing in size, and at the distal end more than twenty rows arranged in four series, gradually diminishing. The largest suckers are scarcely at all oblique, and have the margin cut up by radial grooves into a number of small papillæ, an arrangement also found on the outer margin of the lateral suckers, but not in the terminal ones. The *horny rings* of the largest suckers are smooth; those of the lateral bear about twelve long distant teeth on their outer margin; those of the terminal suckers are similarly armed.

The *Surface* is smooth.

The *Colour* is pinkish yellow, with purplish chromatophores.

The *Gladius* has not been extracted.

Hab. Off Kobi, Japan, 8 fathoms; one specimen, ♀. South of Japan (Station 233 C), 11 fathoms; two specimens, juv. Also (?) Inland Sea, Japan; two specimens, juv.

Loligo edulis, n. sp.

The *Body* is moderately stout, being about three times as long as broad, cylindrical in its anterior third, and tapering gradually to a bluntish point. The *fin* occupies a little more than half the length of the body, rhomboidal, not quite so broad as long, and broadest anteriorly to the middle; the lateral angles are rounded. The *mantle-margin* has a slight projection in the median dorsal line and a broad shallow sinuate excavation ventrally. The *siphon* is of moderate length and bluntly pointed.

The *Head* is small, with prominent rounded *eyes*, and bears the usual auricular crest and preocular pore.

The *Arms* are unequal, the order of length being 3, 4, 2, 1, and about half as long as the body. The first are very slender and bear a distinct keel on the dorsal aspect; the second are thicker and triangular, and have a broad keel almost expanding into a web on the lateral aspect; the third are the stoutest, flattened from above downwards, and distinctly keeled externally; the fourth are intermediate between the third and second, triangular, and with a broadish web extending the whole way up the dorso-lateral aspect. They all have a web up each side of the inner face. The *suckers* are in two series, very oblique, and with slender conical peduncles, their size varying with that of the arms on which they are situated; the *horny ring* bears eight long square-cut teeth on its distal margin. The *hectocotylus* is developed as usual on the left ventral arm, which bears proximally ten rows of suckers, then a minute sucker with an exaggerated peduncle, and beyond this two series of long conical papillæ. The *buccal membrane* has the usual seven angles produced into long lappets, each of which bears about eight suckers in two rows; the *outer lip* is moderately thick; the *inner lip* much thicker and marked with deep radial grooves.

The *Tentacles* are about as long as the body, with flattened *stems*; about one third their length is occupied by the *club*, which is only slightly expanded, and has a protective membrane on either side, but a dorsal web is present only at the extremity. The central *suckers* are about sixteen in number and about one third larger than the laterals; the proximal are about ten; the distal are closely packed in four series. The *horny rings* of the largest are provided with about twenty

larger teeth, with which smaller ones alternate somewhat regularly; the lateral bear about ten distant acute teeth on the outer margin, while the proximal and distal groups are similarly armed on the distal margin.

The *Surface* is smooth.

The *Colour* is a dull yellow with purplish chromatophores.

The *Gladius* is of the usual form, the narrow anterior portion being less than one fourth of the total length.

Hab. Japan; purchased in the market, Yokohama. One specimen, ♂.

Loligo japonica, Steenstrup, MS.

The *Body* is only moderately elongated, being about three times as long as broad, and bluntly pointed behind. The *fin* is a little more than half the length of the body, about as long as broad, rhomboidal, rounded laterally, and very slightly notched at the anterior angles. The *mantle-margin* curves gradually forward to a projecting point in the dorsal median line, and is deeply emarginate ventrally. The *siphon* is short and of the usual form.

The *Head* is comparatively large and rounded; the *eyes* are swollen and prominent.

The *Arms* are unequal, the order of length being 3, 4, 2, 1, and on an average about half as long as the body; the first are very small, slender, and rounded; the second have a prominent ventro-lateral angle, not amounting to a keel; the third have a distinct web on the outer aspect of the distal portion, which is continued backwards as a faint ridge which joins the web lying along the dorsal lateral edge of the fourth. The *suckers* are in two series, and vary in size in accordance with the arms on which they are situated; they are subglobular and oblique. The *horny ring* bears about ten broad, close-set, square-cut teeth. The *hectocotylus* is present on the left ventral arm; the distal suckers of the ventral series only are modified into conical papillæ, some of which bear a minute sucker at their tips. The *umbrella* is absent; the *buccal membrane* is well developed, has the usual seven points, each of which bears a few small suckers (occasionally only one). The *outer lip* is thick, thicker than the *inner*; both are cut up into papillæ along the edge.

The *Tentacles* are as long as the head and body together, and have very slender, almost cylindrical *stems*; the *club* occupies about one fourth of the whole length, and is but slightly expanded. The large central *suckers* are about eight in number and fully twice the diameter of the lateral ones;

proximally to them are about half a dozen suckers of different sizes, and beyond them a large number of diminishing ones arranged in four series and occupying nearly half the length of the club. The *horny ring* in the largest suckers bears about twenty-five square teeth; in the lateral suckers it bears more than twenty close-set bluntly pointed teeth, and in the distal ones about the same number of similar character.

The *Surface* is smooth.

The *Colour* is pale, with purplish chromatophores.

The *Gladius* is of quite typical form, expanded behind, and about six times as long as broad; the narrow anterior extremity occupies less than one third of the total length.

Hab. Japan; purchased in the market at Yokohama. One specimen, ♀.

SEPIA, Linné.

Sepia esculenta, n. sp.

The *Body* is broad, stout, and semielliptical posteriorly. The *fins* are about one fourth of the body in breadth and commence within 6 millim. of the anterior margin, and end within 5 millim. of each other; the *mantle-margin* is produced far over the head dorsally, and evenly truncated below. The *siphon* just reaches the gap between the ventral arms.

The *Head* is broad and the *eyes* laterally prominent.

The *Arms* are subequal, the order of length being 4, 1, 2, 3, and nearly half as long as the body; they are all more or less compressed, especially the ventral ones; they have a distinct web along the outer margin, and a rather broad membrane runs up either side of the sucker-bearing face. The *suckers* are in four series throughout, not very obliquely set; they are large and spheroidal, and have meridional markings on the outer surface; the *horny ring* is smooth and surrounded by a narrow papillate area. In the *hectocotylized* arm of the male the first four rows of suckers are normal, then come two rows of gradually diminishing suckers, succeeded by four rows of minute ones, after which they regain their normal dimensions. The *umbrella* is narrow, widest between the second and third arms, where it reaches up to the fifth row of suckers. The *buccal membrane* has the usual seven points in the male; in the female the two ventral ones are rounded off; the *spermatic cushion* is exceedingly well developed, and has four deep transverse grooves. The *outer lip* is thin and longitudinally corrugated; the *inner lip* is thick and bears numerous very long papillæ.

The *Tentacles* are absent.

The *Surface* is smooth throughout.

The *Colour* is dull grey, mottled with black above, yellowish below.

The *Shell* is elliptical in *outline*, somewhat broader behind (especially in the female); the *chitinous margin* is narrow and does not form a complete ridge across the shell below the spine; it forms two slightly expanded wings behind, and extends but a little distance over the *dorsal surface*, which is marked with coarse rugosities disposed in curved lines parallel to the anterior margin; a distinct but low rib runs down the centre. The *ventral surface* is elevated on either side of a deep median groove; the *last loculus* covers about one fifth of the surface, and is bounded posteriorly by two slightly wavy lines, meeting at an acute angle; the *striated area* is long, and the angle between the striæ widens posteriorly. The *inner cone* is very well developed; the *limbs* arise one fifth of the length of the shell forward, and gradually become more elevated until they enclose a deep conical cavity. The *spine* is strong, pointed, and somewhat curved laterally in the female example.

Hab. Japan; purchased in the market at Yokohama. Two specimens, 1 ♂, 1 ♀.

Sepia elliptica, n. sp.

The *Body* is ovoid, broadest one third from the anterior margin, pointed behind. The *fins* are one third the width of the body, broadest in the middle, extending the whole length of the body, and approaching within 2 millim. of each other posteriorly. The *mantle-margin* not very prominent over the head dorsally. The *mantle-connective* is rather short and deep, but otherwise normal. The *siphon* is conical, reaching within 1 millim. of, or quite up to, the space between the ventral arms.

The *Head* is very short and broad, the *eyes* prominent.

The *Arms* are subequal, the order of length being 4, 3, 2, 1; they are nearly half the length of the body, and taper evenly to fine points; there is a distinct but narrow ridge along the fourth and a delicate web along each side of the oral aspect of the arms. The *suckers* are in four series throughout, and of moderate size, marked with inconstant meridional grooves, and there is a large notch proximally and distally in the rim. The *horny ring* has for the most part no distinct teeth, but is marked in the distal half with shallow irregular notches, which are occasionally more regular. A papillary

area surrounds the horny ring. The *hectocotylus* is developed in about the middle third of the left ventral arm; beyond the eighth row of suckers the two ventral series are continued of the normal size, but the two dorsal are each represented by five minute suckers, gradually diminishing to the middle one and then increasing again; beyond this the arm exhibits no peculiarities. The *umbrella* is widest between the two lateral arms, where it extends as far as the sixth row of suckers. The *buccal membrane* bears the usual seven distinct points in the male, whilst in the female the ventral pair are lost in the thick swollen *spermatic cushion*; this is subdivided by four or five deep grooves into as many transverse ridges. The *outer lip* is thin; the *inner* bears about half a dozen rows of distinct hemispheroidal papillæ.

The *Tentacles* are about as long as the mantle; the *stem* is indistinctly three-sided; the *club* is long and wide, and bears eight series of minute equal suckers; there is a *protective membrane* on either side and a broad *fin* on the dorso-internal aspect. The *horny ring* is small and has a smooth margin.

The *Surface* is smooth.

The *Colour* is a dull grey dorsally, pale yellowish below.

The *Shell* is broad, subelliptical in *outline*, the anterior extremity bounded by two straight lines, which form obtuse rounded-off angles with each other and the sides of the shell; the posterior is rounded gradually off. The *dorsal surface* has a faint ridge passing to each of the three angles just mentioned, and is covered with curved rows of tubercles parallel to the anterior margin. The *ventral surface* is but little elevated; the *last loculus* occupies one third of it, and is bounded behind by a broadly open curve with three or four irregular sinuations in it. The *striated area* is hollowed posteriorly and is marked by grooves corresponding to the sinuations just mentioned. The *inner cone* arises about halfway along the striated area, curves evenly outwards, and then rises into a distinct ridge, forming a wall separate from the margin of the shell; its ventral surface is marked by a number of striæ pointing in the direction of the *spine*, which is of medium length and strength, and curved gently upwards.

Hab. South of Papua (Station 188), 28 fathoms; four specimens, 1 ♂, 3 ♀. Also Station 190, 49 fathoms; four specimens, 1 ♂, 3 ♀.

Sepia Smithi *, n. sp.

The *Body* is of medium breadth, widest one third back,

* Named after Mr. Edgar A. Smith, F.Z.S., of the British Museum.

curving evenly to a pointed posterior extremity. The *fin* is nearly one third the breadth of the body, extending from the anterior margin of the mantle to within 4 millim. of its fellow at the posterior extremity. The *mantle-margin* projects to a considerable extent over the head dorsally, and is slightly emarginate ventrally. The *siphon* is long, reaching up to the interspace between the ventral arms.

The *Head* is of medium breadth and the *eyes* prominent.

The *Arms* are subequal, their order of length being 4, 3, 2, 1; they are a little more than half as long as the body; the dorsal are the smallest and subconical, the ventral wide and with a narrow web on the outer aspect; they all taper gradually to fine points. The *suckers* are in four series throughout, pedunculate, oblique, and notched proximally and distally, and with meridional grooves on the margin; the *horny ring* has about twenty blunt triangular teeth on the distal semicircumference, and is surrounded by a broad papillate area. The *hectocotylus* is not present. The *umbrella* is but slightly developed, reaching in its greatest extent (between the third and fourth arms) only to the fourth row of suckers. The *buccal membrane* has the usual seven points, but there is no *spermatic cushion*. The *outer lip* is moderately thick and longitudinally ribbed; the *inner* is provided with many rows of elevated rounded papillæ.

The *Tentacles* are about as long as the mantle, and have stout three-sided *stems*; the *club* occupies about one fourth of the whole length, and extends fully half round the stem; a protective membrane is found at either side of them and a web along the dorso-median aspect of the club. The *suckers* are very numerous, minute and closely packed; the *horny ring* has about eight or ten stout distant teeth on the distal margin.

The *Surface* is for the most part smooth, but there are about five elongated elevations down each side of the body near the origin of the fin, and a few minute papillæ on the dorsal surface.

The *Colour* is a dull purplish grey above, pale ochre below.

The *Shell* is roughly elliptical in *outline*; the anterior extremity is bounded by two straight lines forming a blunt rounded angle; the sides curve evenly outwards (the greatest breadth being a little anterior to the middle) and form a bluntish point behind. The *chitinous margin* is narrow and vanishes in the median ventral line behind. The *dorsal surface* is rough, with granules arranged in rows parallel to the anterior margin; three slightly elevated tracts diverge from the spine to the three anterior angles. The *ventral surface*

is little elevated; the *last loculus* occupies one fourth of the length, and is emarginate, being bounded behind by a more or less evenly curved line; the *striated area* is excavated, so that the whole shell is thin; the *inner cone* is well developed, with a thickened rounded margin, and encloses a deep pit; the limbs extend halfway along the striated area. The *spine* is long, tapering, and curves gently upwards.

Hab. South of Papua (Station 188), 28 fathoms. Four specimens, ♀.

Sepia sulcata, n. sp.

The *Body* is cylindrical in its anterior fourth, then tapering gradually backwards, and pointed behind. The *fins* are one fifth the breadth of the body, commence 2 millim. from the anterior margin of the mantle, and approach within 5 millim. of each other posteriorly; the *mantle-margin* reaches far over the head dorsally, and is evenly truncated below. The *siphon* does not extend up to the interbrachial space.

The *Head* is broad and the *eyes* very prominent; in the only specimen it is much retracted into the mantle.

The *Arms* are subequal, the order of length being 4, 3, 2, 1; they are one third the length of the mantle, and taper gradually to slender points; the first are thin and rounded, the fourth flattened; each has a distinct ridge on the outer side, which in the fourth expands into a broad membrane. The *suckers* are in two series in the first and second arms, but with a tendency to form four series in the others, more especially in the distal portions; they are pedunculate and very oblique, and the margin is marked with meridional grooves and has a deep distal notch; the *horny ring* is small, smooth, and surrounded by a papillate area. The *hectocotylus* is present along three fourths of the left ventral arm in the form of a groove with convex bottom, bounded on either side by a narrow fillet; on either margin of the groove is a row of minute suckers, which are larger and more distinct, and even form two series on the ventral aspect; the tip of the arm bears two series of small suckers. The *umbrella* is better developed than usual, its greatest extent (between the lateral arms) being up to the eighth row of suckers. The *buccal membrane* has the usual seven points, but not very strongly marked; the *outer lip* is smooth and thin, the *inner* papillate.

The *Tentacle* is as long as the head and body together, with a slender and somewhat flattened stem; the *club* is short and rather broad, and has a protective membrane on either side of the suckers, and a broad web on the dorsal aspect, extending

for a distance equal to half its length down the stem: there are from six to eight rows of very minute *suckers*, subequal, and with smooth *horny rings*.

The *Surface* is smooth, except that on one side of the ventral surface are three slightly raised linear ridges, apparently due to contraction, and a few minute papillæ on the dorsal surface posteriorly.

The *Colour* is on the whole pale, yellowish below, purplish above.

The *Shell* is hemielliptical in *outline* anteriorly, tapering to a point behind. The *chitinous margin* is rather broad, widest about two thirds back; it covers all except the median third of the *dorsal surface*, which is finely rugose where free, and has a slightly elevated median portion and a faint linear ridge in the middle line posteriorly, about 3 millim. long, and terminating 2 millim. from the base of the spine. The *ventral surface* is but little elevated; the *last loculus* occupies more than one third of it, and its posterior boundary is almost semicircular, inflected in the centre. The *inner cone* is evanescent; its limbs are chitinous and form a ventral margin to the terminal cone. A *spine* is present, but, as it had been broken off, its length and form cannot be determined.

Hab. Off the Ki Islands (Station 192), 140 fathoms. One specimen, ♂.

Sepia andreanoides, n. sp.

The *Body* is very long, broadest one third of the way back, pointed and acuminate behind. The fins are narrow, commence 3 millim. behind the anterior margin, and terminate 5 millim. from the posterior end of the body, and passing on to the dorsal aspect of the body, each approaches within 3 millim. of its fellow. The *mantle-margin* extends well over the head dorsally, and is very slightly emarginate ventrally. The *siphon* extends rather further forward than the middle of the eyes, but not up to the space between the ventral arms.

The *Head* is decidedly narrower than the body and somewhat elongated; the *eyes* being distended and laterally prominent.

The *Arms* are subequal, the order of length being 1, 2, 3, 4, or 1, 4, 3, 2; they are two fifths the length of the body, elongated, conical (except the fourth pair, which are flattened), and taper to very slender tips. The *suckers* seem to be normally in four series, but in some cases the arms are so compressed that they seem to be in only two, especially at the proximal extremities of the first and second arms; they are

globular, slightly oblique, with a small aperture and smooth *horny ring*. The *hectocotylus* occupies the distal half of the left ventral arm; the suckers are normal up to the twelfth row, after which the arm widens and has a median groove from which about twelve shallow grooves pass outwards on either side, separating raised portions, each of which bears a minute sucker on the dorsal side of the groove. The *umbrella* is present only between the second and third and third and fourth arms up to the fourth row of suckers. The *buccal membrane* is well developed and has the usual seven points; in the female there is a thick deeply grooved *spermatic cushion*. The *outer lip* is thin and smooth, the *inner* thick and papillate.

The *Tentacles* are somewhat longer than the head and body, very slender and somewhat flattened. The *club* is flattened and expanded; along its outer margin is a very narrow membrane, and along the median edge, at some distance from the cupules, is a broad web, marked on the dorsal aspect with fine parallel shallow oblique grooves; along one margin it bears three or four series of small pedunculated *suckers*, whose *horny rings* bear very numerous and acute teeth.

The *Surface* is smooth.

The *Colour* is a dull purplish grey above, ochre with purple chromatophores below.

The *Shell* has a narrow elongated oval *outline*, somewhat pointed in front and tapering gradually backwards; the *chitinous margin* extends about one third across the *dorsal surface*, which shows the boundary lines of the loculi clearly as brown striæ, and is very minutely roughened: the *ventral surface* is elevated, so that the shell is thick in proportion to its breadth, a narrow groove runs down the centre: the *last loculus* occupies one fourth of the surface and is bounded posteriorly by a shallow open curve. The *posterior extremity* is a very flattened irregular cone, to the apex of which the spine is attached; the *inner cone* is very shallow and its opening is some 4 millim. from the margin of the outer cone. The *spine* is long, straight, and points directly backward.

Hab. Japan; purchased in the market at Yokohama. Three specimens, 1 ♂, 2 ♀.

Sepia kiensis, n. sp.

The *Body* is narrow, widest anteriorly, and tapering gradually backwards: the *fin* is narrow, less than one quarter the breadth of the body, widening a little behind; it commences

1 millim. from the anterior margin and extends to within 2 millim. of its fellow behind. The *mantle-margin* is prominent dorsally and slightly emarginate ventrally. The *siphon* does not quite extend to the bases of the arms.

The *Head* is broad, and the *eyes* rounded and prominent.

The *Arms* are subequal, the order of length being 4, 3, 2, 1; they are very short, about one third the length of the body; the first and second are conical, the third flatter, with a slight ridge externally, and the fourth broad and flat with a distinct crest. The *suckers* are in four series throughout, small, spheroidal, and not very oblique; the *horny ring* is smooth. The *hectocotylus* is not developed. The *umbrella* is evanescent, extending at most only up to the second row of suckers: the *buccal membrane* has five points and is rounded dorsally; the *spermatic cushion* is but slightly developed. The *outer lip* is thin and grooved longitudinally, the *inner* thicker and papillate.

The *Tentacle* is as long as the head and body; the *stem* being slender and indistinctly three-sided. The *club* is very slightly expanded; a protective membrane, grooved obliquely on the dorsal aspect, is situated on the outer margin, and there is a web on the internal side. The *suckers* are in four or five series, which are slightly larger towards the inner margin; the *horny ring* presents a few acute teeth.

The *Surface* is smooth throughout.

The *Colour* is a dull reddish grey above, yellowish below.

The *Shell* is a very elongate oval in *outline*; the *chitinous margin* is very narrow and extends only slightly over the *dorsal surface*, which is finely granular and marked by the divisions between the loculi: the *ventral surface* is somewhat elevated and marked by a distinct but not very deep median groove; the *last loculus* extends over more than one third of the shell and is bounded posteriorly by an almost semicircular line; the *striæ* are very close; the limbs of the *inner cone* arise about midway along the shell, pass backwards as low, narrow, smooth fillets, and unite behind without forming any deep cavity; the *posterior extremity* is curved towards the ventral aspect and ends in a narrow blunt cone, to the apex of which is attached the straight dorsally directed spine.

Hab. Off the Ki Islands, south of New Guinea (Station 192), 140 fathoms. One specimen, ♀.

Sepia kobiensis, n. sp.

The *Body* is long and narrow, widest near the anterior margin, and tapers gradually backwards. The *fin* is very narrow, only one eighth of the body; it commences 3 millim.

from the margin of the body and posteriorly passes on to the ventral surface and terminates 2 millim. from its fellow and 4 millim. from the extremity of the body. The *mantle-margin* has a narrow projection over the head, and is evenly truncated ventrally. The *siphon* is short, not reaching halfway to the space between the ventral arms.

The *Head* is of medium breadth, and the *eyes* prominent laterally.

The *Arms* are subequal, the order of length being 2, 4, 3, 1, and less than one third of the length of the body; the first two pairs are subconical and slender, the third broader and with a web running up the ventral aspect, the fourth wider and with a distinct ridge along the outer edge; they all taper to very fine points. Many of the *suckers* are deficient, but they seem to have stood in four series throughout; they are spheroidal and very oblique; the distal margin of many has a deep notch: the *horny ring* is smooth in most cases, but occasionally possesses a few angular teeth. The *hectocotylus* is not developed. The *umbrella* is but little developed, its greatest extent being on the ventro-lateral aspect, where it reaches the fourth row of suckers. The *buccal membrane* has the usual seven points, the two ventral being the least distinct (as usual in female specimens); the *spermatic cushion* is small. The *outer lip* is narrow, the *inner* wide and papillate.

The *Tentacle* is shorter than the body and slender; the *stem* has three sides, the inner being slightly hollow, with a slender fillet along the middle. The *club* is slightly expanded with a distinct protective membrane; the inner side of the club is deeply grooved, and internally to the groove is a rather broad fin. The *suckers* are in about five series; near the inner margin are three rather larger than the rest, which gradually diminish towards the outer margin. The *horny rings* of the larger suckers have about twenty fine teeth on the distal semicircumference, the smaller have fewer in proportion.

The *Surface* is smooth all over.

The *Colour* is a dark purplish grey above, paler below.

The *Shell* is a very elongated oval in outline; the *chitinous margin* is very narrow and extends one third over the *dorsal surface*, which is smooth and evenly convex, with the exception of a slight ridge along the middle line: the *ventral surface* is elevated, so that the shell is thick, with a shallow median groove becoming evanescent posteriorly; the *last loculus* occupies one third of the surface and is bounded by a slightly curved line with a cusp where the median groove meets it: the *inner cone* is formed by two limbs, which arise halfway along the shell and form rounded fillets slightly

more elevated posteriorly, where they bound a shallow depression: outside them the margin of the shell expands into a subcircular plate, from the centre of which the *spine* projects backwards; no information can be given as to its form or length, as it has been broken off close to the base.

Hab. Kobi, Japan, 8 fathoms. One specimen, ♀.

Sepia papuensis, n. sp.

The *Body* is elongated, broadest about one third back, pointed behind: the *fins* extend the whole length of the body and are one third of its breadth, a little wider behind; they extend to within 1 millim. of the anterior margin, but are separated by about 5 millim. posteriorly: the *mantle-margin* projects far over the head dorsally, and is slightly emarginate ventrally. The *siphon* is conical, reaching two thirds up to the gap between the ventral arms.

The *Head* is short and broad; the *eyes* prominent.

The *Arms* are subequal, their order of length being 4, 3, 1, 2; they are about one fourth as long as the body and taper to fine points: the dorsal are conical with a very slight ridge up the outer aspect, the third pair have a similar ridge; the ventral are flattened and bear a distinct crest. The *suckers* are in four series throughout and of moderate size, set obliquely on short peduncles, with meridional grooves on the outside: the *horny ring* bears from twenty to twenty-five long, square-cut, irregular teeth in its distal semicircumference, and outside it is an area covered with close-set papillæ. The *hectocotylus* is not developed. The *umbrella* is slight, reaching only as high as the sixth row of suckers between the third and fourth arms, where it is widest; as usual it is entirely absent between the two ventral arms. The *buccal membrane* has the usual seven points. The *spermatic cushion* is not developed: the *outer lip* is smooth, except for a few ridges due to contraction; the *inner lip* bears numerous small papillæ.

The *Tentacles* are about as long as the body, the *stem* being three-sided: the *club* is short, flattened, and expanded, with a protective membrane on either side and a broad web down the back, reaching along the stem for a distance equal to half the length of the club; it bears six larger *suckers* in the central row, a series of smaller ones on either side, and some very minute ones along each margin; at the top are from fifteen to twenty in four series. The *horny ring* of the large suckers has from twenty-five to thirty teeth in its distal semicircle; those of the smaller about ten.

The *Surface* is smooth, except for a few irregular incon-

stant papillæ on one side of the ventral surface and below the eye.

The *Colour* is a pale yellowish grey, darker above.

The *Shell* is oval in *outline*, broadest anteriorly to the middle, tapering somewhat rapidly in front and ending in a semicircle; posteriorly it tapers gently, and, then rounding off, ends in two almost straight lines, which meet at a right angle at the base of the spine. The *chitinous margin* extends but slightly over the *dorsal surface*, which shows two grooves diverging as they pass forwards, separating three ribs, and is covered with rounded papillæ arranged in curves parallel to the anterior margin. The *ventral surface* has a rather deep and broad median groove: the *last loculus* occupies one third of its extent, and is bounded posteriorly by a wavy line with three parts; the *striated area* is hollowed, so that this part of the shell is thin: the *inner cone* commences by two limbs, which arise halfway along the striated area, curve outwards, and unite below the posterior apex with a broad chitinous band passing from one side of the shell to the other and forming a rather deep *outer cone*: the *spine* is short (but has been broken off); it bends slightly upwards and has a narrow longitudinal keel on its ventral surface.

Hab. South of Papua (Station 188), in 28 fathoms. Two specimens, ♀.

Sepia cultrata, Steenstrup MS.

The *Body* is elongated, broadest about the middle of its length. The *fins* are rather narrow, about one fourth the breadth of the body, commencing 2 millim. from the anterior edge of the body and approaching within 5 millim. of each other posteriorly; the left is somewhat broader than the right. The *mantle-margin* extends far over the head dorsally and is not emarginate but slightly undulating ventrally. The *siphon* is short, terminating far short of the depression between the ventral arms.

The *Head* is broad, and the *eyes* very prominent.

The *Arms* are subequal, the order of length being 4, 3, 1, 2; they are one fourth the length of the body, all are flattened and taper evenly to fine points. The *suckers* are in four series, except in the right dorsal arm, where they appear to be in two, probably owing to its state of extreme compression; they are of medium size, many are deeply notched proximally and distally, and provided with fine meridional grooves on the margin: the *horny ring* is smooth and surrounded by a papillary area. The *hectocotylus* is not

developed. The *umbrella* is small, widest between the lateral arms, where it reaches up to the sixth or seventh row of suckers. The *buccal membrane* has five distinct points, the ventral edge being thickened and forming a large folded *spermatic cushion*; it bears no suckers. The *outer lip* is thick, and marked with fine longitudinal grooves; the *inner* is papillate.

The *Tentacles* are as long as the mantle, with a three-sided flattened *stem*, much broader proximally than distally. The *club* is slightly expanded, with a narrow protective membrane below, a broad one above, and a distinct web outwardly. There are five or six series of *suckers*, slightly larger in the middle than at the margins, on very long slender peduncles: the *horny ring* is smooth.

The *Surface* bears a number of small irregularly scattered papillæ, four or five elongated warts near the origin of the fins on the dorsum, and some folds in the skin on the ventral surface; probably these last are due to contraction.

The *Colour* is a dull grey, with a bluish shade above, inclining to yellow below.

The *Shell* has an elongate oval *outline*, broadest one third of the way back and rounded off at both ends. The *chitinous margin* is narrow anteriorly, then broader, evanescent posteriorly, a deep calcareous ridge forming the posterior extremity of the shell; it extends very little over the *dorsal surface*, which bears only faint indications of a median ridge and is beset with fine granules disposed in rows parallel to the anterior margin. The *ventral surface* is elevated so as to give the shell a more than average thickness: the *last loculus* occupies one third the surface and is bounded by a transverse hemi-elliptical curve: the *striated area* is excavated, but slightly convex in the middle line. The *inner cone* consists only of the slightly elevated limbs, which run along three quarters of the striated area and unite with each other as a flattened fillet posteriorly. The *spine* has lost its extreme point, but is strong, and has a raised knife-like ridge developed upon its ventral aspect *.

Hab. Off south-east coast of Australia (Station 163), depth 2200 fathoms. One specimen, ♀.

METASEPIA, subgen. nov.

Sepia (*Metasepia*) *Pfefferi* †, n. sp.

The *Body* is short and stout, broadest about the middle of

* Whence the specific name.

† Named after Dr. George Pfeffer of the Hamburg Museum.

its length, very thick (dorso-ventrally), and bluntly rounded behind. The *fins* are one fourth as broad as the body and placed much nearer the dorsal than the ventral surface; they commence 2–3 millim. from the anterior margin and are connected by a narrow fillet behind; a slightly raised ridge passes down the ventro-lateral aspect of the body, similar to that seen in many specimens of *Octopus* and *Eledone* (possibly due to contraction). The *mantle-margin* projects very slightly dorsally and is a trifle emarginate opposite the funnel: the *connective cartilages* are deeper than in most species of *Sepia*, but there is no distinct knob as in *Sepiella*. The *siphon* reaches up to the depression between the ventral arms.

The *Head* is broad, and the *eyes* prominent.

The *Arms* are subequal, in order of length 3, 4, 2, 1; they are rather more than half as long as the body and distinctly three-sided, having a ridge on the outer side of each, broadest on the ventral ones; they taper evenly to very fine points; the inner surface of each is roughly papillate and has hemispherical depressions into which the suckers are retracted. The *suckers* are in four series throughout, almost hemispherical, not very oblique, and marked with meridional grooves: the *horny ring* bears irregular square teeth. The *hectocotylus* is not developed. The *umbrella* is larger than usual in the genus, reaching on an average about one third up the arms; the *buccal membrane* has seven not very prominent points, and there is a *spermatic cushion* as usual: the *outer lip* is very thin, the *inner* thick and papillate.

The *Tentacle* is about as long as the body, stout, indistinctly three-sided, and tapering. The *club* is short and but little expanded, with a narrow protective membrane on its outer side; the sucker-bearing area is, as it were, undermined on its inner aspect by a deep groove or fissure, and internally to this again is a broad fin which reaches down the tentacle for a distance exceeding half the length of the club. There are three *suckers* much longer than the rest, whereof the middle one is the largest and the proximal the next, placed on stout peduncles arising in deep depressions; towards the outer side of the club is a series of about four medium-sized suckers, and beyond these again one or two series of minute ones. The *horny rings* appear smooth under a powerful lens.

The *Surface* is smooth in general, but there are a few irregular papillæ in the ventro-lateral region.

The *Colour* is a dull grey, with indications of annular markings on the back.

The *Shell* has a rhomboidal *outline*, with rounded anterior and lateral angles; the *chitinous margin* is narrow, widest

behind, where it forms a flat, acute-angled plate, the posterior extremity of the shell; it covers entirely, however, the *dorsal surface*, which is slightly raised mesially and marked by a number of faint striæ radiating from the posterior end. The *ventral surface* is much elevated on either side of a median groove; the *last loculus* occupies one sixth of the surface, is bounded by a wavy line, and deeply emarginate in the middle. The *inner cone* is represented only by a narrow rib reaching halfway along each posterior side of the shell and meeting its fellow in a rounded angle behind, from which a number of radiating calcareous streaks pass outwards into the horny termination.

Hab. South of Papua (Station 188), 28 fathoms. One specimen, ♀.

Œgopsidæ.

Histiopsis, Hoyle.

Histiopsis, Hoyle, 1885, Narr. Chall. Exp. vol. i. p. 273 (*nomen tantum*).

Resembles *Calliteuthis*, Verrill, in the shape of the body and fin and in the pigment spots scattered over it, but has a web extending for some distance between the dorsal, dorso-lateral, and lateral arms: the suckers are in two series. The siphon has a suspensory ligament and a valve. The gladius has not been removed.

Histiopsis atlantica, Hoyle (*loc. cit.*).

The *Body* is short, conical; acuminate and curving gently downwards posteriorly. The *fin* is about one third the length of the body and considerably broader than long; each half is roughly semicircular and narrows in to its insertion both in front and behind. The *mantle-margin* is in general transverse, but projects slightly as a blunt rounded angle in the dorsal median line. The *mantle-connective* consists of a groove with a narrow median fillet in the mid-dorsal line fitting into a corresponding cartilaginous surface on the back of the neck, and of a long linear ridge extending up to the margin, which fits into a shorter groove on the base of the *siphon*; this is broad, short, and conical, and has a thick suspensory ligament, through the skin of which two muscles may be distinguished, and a distinct valve.

The *Head* is as large as the body, rounded at the sides and flattened above and below. The *eyes* appear to have been enormous; one is distended and protrudes from its orbit, whilst

the other is shrivelled. There is no auricular crest and no preocular pore, but behind each eye is a white papilla.

The *Arms* are about equal in length to the head and body together; the dorsal are the shortest, the other three pairs subequal, the order of length being 3, 4, 2, 1; they are quadrilateral with rounded angles externally, with two slightly raised ridges internally, on which the suckers are situated; they taper gradually to very slender tips; the third pair have a delicate narrow web along the third quarter of their outer aspect. The *suckers* are in two series throughout; they are small and distant along the proximal third (the webbed portion) of the arms, then larger and closer, and finally minute and very closely set towards the tips; they are set transversely on short conical peduncles, spheroidal with a swollen band round the face. The *horny ring* is smooth proximally; distally it bears about five close-set, broad, bluntly rounded teeth. No trace of a *hectocotylus* could be found. The *umbrella* is found only between the dorsal, dorso-lateral, and lateral arms; it takes origin from the sucker-bearing ridge and extends about one third up the arms. The *buccal membrane* is broad and somewhat contracted over the mouth; it has the usual seven points, but they are very blunt and indistinct; it is united by three ligaments with the web between the dorsal and dorso-lateral arms, by a ligament with the inner side of each ventro-lateral arm on its ventral aspect and by another to the inner surface of each ventral arm, there being altogether seven ligaments. The membrane bears no suckers; its inner surface is much creased and folded. The *outer lip* is very thin and smooth, and hidden between the creased integument of the buccal membrane and the *inner lip*, which is thick and marked with irregular radial grooves.

The *Tentacles* have been removed; the stumps which remain are not half the length of the arms; they are quadrangular and flattened from above downwards.

The *Surface* bears a large number of papillæ, slightly elevated, resembling those of *Calliteuthis*; they are arranged most thickly on the ventral aspect of the head and body, but also on the dorsal, and extend up the outer aspect of the arms, three series on the ventral arms, two on each of the others. Near the tip of each dorsal arm is a series of four or five black, elongate, egg-shaped swellings, gradually diminishing in size, and forming apparently an extreme development of the papillæ above mentioned. The second pair of arms appears to have been similarly provided; the third has been so stripped of integument towards the tips that it is impossible to ascertain their original condition. In the fourth the warts at the tip are quite similar to those lower down the arm.

The *Colour* is a dull purplish madder, paler above than below; the papillæ are a deep black, with a white centre, usually situated towards the anterior margin. The *buccal membrane*, both sides of the umbrella, and the inner surfaces of the arms, so far as this extends, are a deep purple.

The *Gladius* has not yet been extracted from the solitary individual.

Hab. South Atlantic (Station 333), 2025 fathoms. One specimen, sex?

XXI.—*New Species of* Histeridæ, *with Synonymical Notes.* By George Lewis.

The present paper is supplementary to one in this magazine of last June, and treats of thirty-two species, twenty-four of which are now described as new.

Two of the species are *Onthophili*, making the total number of described species in the genus nineteen; and as there is no reason for believing this genus to be less circumscribed in its distribution than *Platysoma* or *Paromalus*, although its members are much more difficult to capture, the genus will without doubt ultimately prove to be a large one.

The genus *Onthophilus* is a very interesting one, as the chitin of the exoskeleton is exceedingly opaque and evidently less pure than in the other genera of Histeridæ; and although some of the species, such as *sulcatus*, are beautifully engraved above, the substructure is, as it were, roughly hewn, and the meso- and metasternal plates, as well as the abdominal segments, are coarsely wrought at the sutures. When the chitin of Coleoptera has the appearance of opacity and impurity, we often see it accompanied with elaborate sculpture; and this is, in fact, so general that it is impossible to avoid the conclusion that the composition of the chitin is in some way the cause of the costæ and punctures which constitute the sculpture. Sculpture and opaqueness are most obvious in those Curculionidæ and Tenebrionidæ which inhabit sandy places or the plains of extensive deserts; but they are by no means confined to members of these families, for they exist in a marked degree in many other insects which share their habitat.

Amongst the Histeridæ there is one very remarkable species, *Hister costatus*, from Mexico, which has the opaque exoskeleton and the sculpture of *Onthophilus*, and it is the more worthy of notice because three hundred species of the genus *Hister* have purer chitin and a much less highly wrought sculpture.

Lately I have had some analyses made in an endeavour to discover what the elements are besides chitin in *Brachycerus* and other desert species possessing a very opaque skeleton; but the results show that it is a line of investigation requiring the life-labour of a first-class chemist rather than of a few experiments conducted in the laboratory under the direction of an entomologist.

List of Species, arranged generically.

Hololepta æqua.
—— prona.
—— maura.
—— Sahlbergi.
—— Belti.
—— complanata, *Palis. Beauv.*
Lioderma nudum.
Apobletes fictitius.
—— planisternum, *Lewis.*
Platysoma cinnamomeum, *White.*
—— punctulatum.
—— sexstriatum.
—— exiguum.
Pachycræerus bellulus.
—— Raffrayi, *Lewis.*
Ebonius politus.
Hister indicus.
—— calidus, *Erichson.*
—— carnaticus.
—— martius.
—— Raffrayi.
—— occidentalis.
—— limbatus, *Truqui.*
Carcinops striatisternum.
Triballus minimus, *Rossi.*
—— tropicus.
—— montanus.
Saprinus lautus, *Wollaston.*
Onthophilus tuberculisternum.
—— bipartitus.
Idolia lævigata.
—— punctisternum.

Hololepta æqua, n. sp.

Oblongo-ovata, plana, nigra, nitida; fronte æquali; pronoto stria marginali tenui pone oculos terminata, basi ante scutellum bisinuato; elytris margine inflexo subtiliter rugoso, striis 3 dorsalibus brevissimis prima appendiculata; propygidio lateribus parce punctato, apice bifoveolato; pygidio dense et grosse punctato. L. $7\frac{1}{2}$ mill.

Hab. Assam.

H. æqua is closely allied to *indica*; it differs in being narrower and much smaller, and in having three elytral striæ, the first having a somewhat long appendicle.

Hololepta prona, n. sp.

Oblongo-ovata, subdepressa, nigra, nitida; fronte lævi; pronoto basi bisinuato, margine basi continuato, lateribus minime punctato, stria interna ante basin evanescente; elytris striis, prima in medio late interrupta, secunda brevi subappendiculata; prosterno parce cincto-punctato, apice subbifoveolato; pygidio sat dense punctato; prosterno medio parum constricto. L. $9\frac{1}{2}$ mill.

Hab. Cape of Good Hope (*ex coll. Monchicourt*).

H. prona differs from *maura* as follows:—the margin of the thorax is continued round the basal angle, the internal

stria occupies two thirds of the length of the thorax only, and the prosternum is anteriorly less wide.

Hololepta maura, n. sp.

Oblongo-ovata, subdepressa, nigra, nitida; fronte lævi; pronoto immarginato basi bisinuato, lateribus magis dense punctato, stria basi continuata; elytris striis, prima in medio interrupta, secunda brevissima et appendiculata; propygidio sparse cincto-punctato, apice bifoveolato; pygidio sat dense subocellato-punctato; prosterno medio sinuato; mesosterno antice marginato, subrecto. L. $9\frac{1}{2}$ mill.

Hab. Abyssinia (*Raffray*).

This species is allied to the preceding, but the prosternum is broader and less narrowed in the middle, the base being half as wide again as the apex; in this respect it is like *plana*. Also the thorax is more densely punctured at the sides, the thoracic margin is absent, and the lateral stria is carried round the basal angle, and anteriorly it terminates in a shallow fovea. In *maura* and in *prona* there is a line, not well defined, on the thorax in front of the scutellum.

Hololepta Sahlbergi.

Oblonga, depressa, nigra, nitida; fronte punctulata, striis 2 transversis brevibus; pronoto lateribus sat dense punctato, stria marginali basi continuata; elytris margine inflexo lævi, striis 2 dorsalibus, prima brevi, secunda integra; propygidio late circumpunctato, medio linea haud distincta; pygidio parce punctato. L. 7 mill.

Hab. Brazil (*Dr. Sahlberg*, no. 2794).

This species may be placed near *cubensis* and *caracasia*. The second elytral stria is complete, as in *lamina*, but deviates at both ends from the straight line; the propygidium is very broadly punctured (not wholly so, as in *caracasia*), and the pygidium is unevenly punctured, the punctures becoming almost obsolete at the base. The elytral striæ and facies are similar to those of *Lioderma rimosum* and *minutum*, but the wide prosternum brings *Sahlbergi* into the genus *Hololepta*.

Hololepta Belti, n. sp.

Ovata, brevis, complanata, nigra, nitida; fronte plana, striis 2 transversis arcuatis subobsoletis; pronoto lateribus anguste punctato, ante scutellum bisinuato, stria marginali tenui; elytris margine inflexo lævi; stria subhumerali valida, basi abbreviata, 2 dorsalibus obliquis, secunda brevissima, appendiculata; propygidio punctis

sparsis cincto, pygidio densissime punctulato; prosterno apice sinuato, immarginato; mesosterno modice sinuato. L. 7 mill.

Hab. Chontales (*Belt*).

This species is allied to *curta*, but is shorter: the chief distinguishing characters are the absence of a long dorsal stria, the fine and dense punctuation of the pygidium, and the sinuosity in the apex of the mesosternum.

Hololepta complanata, Palis. Beauv. Ins. Afr. et Am. p. 179, t. vi. fig. 5, appears to be closely allied to *Lioderma rimosum*; but the description as under does not quite accord with it in respect to the third stria, which is not visible in *rimosum*:—"*Hister complanatus.* Depressus, nigrescens, thorace lævi, utrinque antice puncto impresso; elytris abdomine multo brevioribus; striis 3, interiore brevissima; mandibulis exsertis integris. Saint Dominique.

"*Obs.* Cette espèce, un peu plus petite que la précédente [*Lioderma 4-dentatum*], se distingue par son corps presque aussi plat que la Punaise des lits, et par la strie la plus intermédiaire qui ne se prolonge que vers le milieu de l'élytre. De plus, le bas des élytres, dans l'Escarbot à Quatre Dents, est tronqué de manière à former l'échancrure d'un cœur. Enfin la couleur de l'Escarbot aplati est d'un noir brun et non luisant."

Lioderma nudum, n. sp.

Oblongo-ovatum, subdepressum, nigrum, nitidum; fronte impunctata, striis 2 transversis brevibus; pronoto marginato, lateribus obsolete punctato, stria interna basi abbreviata; elytris striis, prima integra, secunda brevi appendiculata, tertia brevissima; propygidio punctis parcis cincto, apice bifoveolato, pygidio dense punctato; prosterno antice angustato, postice trigono; mesosterno antice marginato et subsinuato. L. 9 mill.

Hab. Ashanti.

This species is doubtless very close to *caffra*, but the elytral striæ are different, and the thoracic punctures are nearly absent and lie in a small cluster near the middle of the margin. The thorax is marginate; the lateral stria does not quite touch the base, and in front terminates at the same point as the margin behind the eye. The prosternum is narrow until it widens out at the base in the form of a triangle; this last character is also seen in *caffra*.

Apobletes fictitius, n. sp.

Oblongo-ovatus, complanatus, piceus, nitidus; fronte concava,

stria recta supra oculos interrupta; pronoto subtilissime punctulato, margine tenuissime elevato, stria haud valida, pone oculos evanescente, interstitio haud lato; elytris striis 1 et 2 validis, integris, 3 in medio interrupta, 4 basali; propygidio transversim grosse punctato; pygidio undique ocellato-punctato, margine (basi excepta) elevato; prosterno lævi; mesosterno transverso, late sinuato, stria marginali integra. L. 5 mill.

Hab. Gilolo (*Wallace*).

A. fictitius is sculptured above almost exactly to the pattern of *Platysoma planisternum*, but in the former the forehead is concave. Beneath, the two species are also alike in the great width of the mesosternum, but in *fictitius* there is a well-marked marginal stria, while in the other the surface is quite plain.

Platysoma planisternum, Lewis, should be placed in the genus *Apobletes.*

Platysoma cinnamomeum, White.—The following is White's description of this species :—" Smooth, deep rich purplish brown; head in front considerably hollowed out; elytra near the sides with three slightly curved, deeply impressed lines, and three shallow impressed lines at the end of each elytron between these and the suture. L. $1\frac{3}{4}$ lines."

Hab. New Zealand (*Capt. Parry*).

Platysoma punctulatum, n. sp.

Oblongo-ovatum, subdepressum, nigrum, nitidum, supra punctulatum; fronte leviter concava, stria subrecta; pronoto stria laterali integra, basi continuata; elytris striis 1–3 integris, 4 basi abbreviata, 5 dimidiata, 6 obsoleta; pygidio convexo ocellato-punctato; prosterno lobo marginato, punctulato; mesosterno stria integra. L. 5 mill.

Hab. Assam.

This species has the facies of many characters in common with *capense*, which is very remarkable, because the localities of these species lie 5500 miles apart. The abdomen beneath is punctured alike in both species.

Platysoma sexstriatum, n. sp.

Oblongum, subparallelum, subconvexum, nigrum, nitidum; fronte concava, stria integra supra oculos angulata; pronoto stria laterali integra; elytris striis dorsalibus 1–3 integris, 4 et 5 brevissimis; propygidio transversim punctato; pygidio grosse punctato, margine fortius elevato; mesosterno sinuato et marginato. L. 5 mill.

Hab. Java (*Raffray*).

This species is very near to *striale* and *Robestorfi*, the most conspicuous differential character being the strongly elevated margin to the pygidium in the present species. The dorsal striæ are three in number, with slight indications of the fourth and fifth at the extreme apex.

Platysoma exiguum, n. sp.

Oblongum, parallelum, subconvexum, ferrugineum, nitidissimum; fronte subconcava subtilissime punctulata, stria transversa recta fortiter impressa; pronoto stria marginali integra pone oculos angulata, lateribus subtilissime punctulato; elytris striis 1 et 3 integris, 2, 4, et 5 ante basin terminatis, suturali anterius abbreviata; propygidio grosse punctato; pygidio lævi, profunde bifoveolato (ut in *P.* 10-*striato*); prosterno lobo parce punctato marginato; mesosterno stria integra late impressa; tibiis anticis acute 4-, posticis 3-denticulatis. L. $2\frac{1}{4}$ mill.

Hab. Dikoya, Ceylon. Discovered by my brother, A. R. Lewis, in 1878; and a second specimen I found myself in the spring of 1882.

The above is the smallest known *Platysoma*, and is allied to 10-*striatum*, Motsch.; the mandibles in *exiguum* are very fine and acute, with one large tooth in the middle.

Pachycrœrus bellulus, n. sp.

Oblongus, cylindricus, viridi-cyaneus, nitidus, punctulatus; fronte epistomoque marginatis, hoc impresso, stria transversa late interrupta vel obsoleta; pronoto stria marginali antice interrupta; elytris striis 1–4 integris, 5 et 6 basi evanescentibus; propygidio pygidioque fortius punctatis; prosterno stria marginali parallela, mesosterno stria antice interrupta. L. $4\frac{1}{4}$ mill.

Hab. Abyssinia (*Raffray*).

This species in stature is intermediate between *nigro-cœruleus* and *Raffrayi*, and is closely allied to the latter. The chief differences lie in the fourth and fifth elytral striæ, in the prosternal striæ, and in the thoracic punctures; the last in *bellulus* are finer.

Pachycrœrus Raffrayi has the prosternal striæ sinuate, widening out in the middle; the thorax has a well-defined fovea before the scutellum, and the epistoma is somewhat excavated. In *nigro-cœruleus* the stria of the mesosternum is well defined and the prosternal lateral striæ are parallel, as in *bellulus*.

Crypturus argiolus, Rossi, noticed in the 'Zoological

Record,' 1883, as a Histerid, does not belong to the Coleoptera.

Ebonius, n. gen.

Corpus subcylindricum, haud depressum. Caput retractile. Antennæ sub frontis margine insertæ, clava ovali 4-articulata, foveola profunda sub angulo prothoracis. Pronotum antice angustatum. Prosternum latum, marginatum. Tibiæ extus dentatæ. Propygidium transversum; pygidium supra convexum apice reflexum.

This genus may be placed next to *Omalodes*, from which it can be at once separated by the broad prosternum, the more parallel form, and the singular pygidium, which is double, as in Horn's genus *Teretriosoma.*

Ebonius politus, n. sp.

Oblongus, subcylindricus, supra depressus, niger, nitidus; fronte grosse punctata, margine plano antice interrupto; pronoto stria integra, punctato, ante scutellum foveolato; elytris striis tenue impressis, 1–3 suturalique integris, 4 et 5 punctiformibus, medio abbreviatis; propygidio utrinque punctato; pygidio medio subtuberculato et grosse punctato. L. $8\frac{1}{2}$–9 mill.

Hab. Para.

There are two examples of this curious insect in the British Museum, and I purpose shortly to give figures of both the upper and under surfaces. The fore tibiæ have five or six teeth; the middle and hind pairs three each.

Hister indicus, n. sp.

Suborbicularis, convexus, niger, nitidus; fronte subtilissime et parce punctulata, stria circulari; pronoto parce punctulato, stria interna integra, valida, externa nulla; elytris striis crenatis, subhumerali valida impressa, 1–4 integris, 5, basali rudimento aucta, suturalique in medio, abbreviatis; propygidio pygidioque dense et grosse punctatis; prosterno basi lato et marginato; tibiis multispinosis. L. $4\frac{1}{2}$ mill.

Hab. Assam.

H. indicus is close to *concordans*, a species found in the Deccan. The differences lie in the absence of the short internal thoracic stria, the deep and complete subhumeral stria, the large and deep punctuation of the pygidium, the widening out of the base of the prosternum, and the lesser dilatation of the fore tibiæ, which are armed with seven or eight spines in the place of four teeth as in *concordans.*

Hister calidus, Er. I give the diagnosis of this species; it

appears to me to be identical with *H. striolatus*, but an examination of the type can alone decide this point:—"*H.* ovalis, subdepressus, niger; thorace lateribus sesquistriato; elytris striis dorsalibus integris, laterali exteriore nulla; tibiis anticis 3-dentatis. *Hab.* Senegal. L. 4 lin. (Affinis *H. memnonio.*)"

Hister carnaticus, n. sp.

Ovalis, subconvexus, niger, nitidus; fronte subtilissime punctulata, inæqualiter impressa, stria integra, modice valida, antice recta; pronoto antice bisinuato, stria laterali interna integra, externa vix abbreviata; elytris striis 1–4 validis, integris, 5 brevissima, suturali brevi media; propygidio punctis sparsis cincto; pygidio lævi; prosterno plano, emarginato; mesosterno sinuato, stria integra; tibiis anticis 3-dentatis, posticis biseriatim multispinosis. L. $6\frac{1}{2}$ mill.

Hab. Nilghiri Hills.

This species belongs to an Indian group which embraces *corax* and *coracinus*. *H. carnaticus* differs chiefly in having the fourth dorsal stria deep and complete and the transverse band of punctures on the base of the pygidium obsolete. The group represented by *encaustus* and *thibetanus* has certain characters in common with the above, and in a systematic list the two clusters may be brought together with advantage.

Hister martius, n. sp.

Ovalis, parum convexus, niger, nitidus; antennis pedibusque rufis; fronte punctulata, stria profunde impressa; mandibulis extus marginatis; pronoto basi punctato marginato, striis 2 lateralibus integris profunde impressis; elytris rubris macula communi angulata nigra, striis validis 1–4 integris, 5 in medio subinterrupta, suturali ultra medium abbreviata; propygidio pygidioque sat dense ocellato-punctatis; prosterno postice angusto marginato, lobo punctato, in medio utrinque sulcato; mesosterno arcuato, marginato; tibiis anticis 4-dentatis, posticis biseriatim spinulosis. L. 3 mill.

Hab. Abyssinia (*Raffray*).

This species is allied to *laco*. It is slightly more convex, the interstice between the thoracic margin and the outer stria is much broader, the apex of the mesosternum is arcuate, and the propygidium and the pygidium are densely marked with ocellated punctures. The last character brings it near to *kurdistanus*.

Hister Raffrayi, n. sp.

Ovalis, subconvexus, nigro-piceus, nitidus; fronte stria valida integra

antice subrecta; pronoto marginato, stria laterali interna integra, externa subintegra, basi punctato; elytris striis, subhumerali nulla, 1–4 integris, 5 in medio abbreviata, suturali arcuata dimidiata; propygidio parce et grosse punctato; pygidio apice lævi; prosterno basi rotundato; mesosterno apice subsinuato, stria integra, tibiis antice valide 3-dentatis, posticis spinulosis. L. 4 mill.

Hab. Abyssinia (*Raffray*).

This insect may be placed next to *martius*. There is no *Hister* at present in the list which has the fore tibiæ so strongly denticulate, although in this characteristic *castaneus* approaches it.

Hister occidentalis, n. sp.

Ovalis, convexus, niger, nitidus; stria frontali semicirculari; pronoto stria laterali interna unica integra, margine punctato; elytris striis 1–4 dorsalibus integris, 5, rudimento aucta, suturalique in medio, abbreviatis; propygidio pygidioque sat dense æqualiter punctatis; prosterno margine striato; mesosterno subsinuato, stria integra; tibiis anticis 7–8-denticulatis, posticis parce spinosis. L. 5 mill.

Hab. China (? Shanghai).

This species connects the fauna of Asia with that of America, as it is very closely allied to *cognatus*. It differs in the fifth elytral stria being abbreviated in the middle and rudimentary at the base, in the thoracic punctuation widening out into a cluster behind the eyes, and in the propygidium and pygidium being much less densely punctate. The specific name indicates its locality from an American standpoint.

Hister limbatus, Truqui.—I possess an entirely black example of this somewhat rare species from Abyssinia.

Carcinops striatisternum, n. sp.

Oblongus, parallelus, parum convexus, niger, nitidus; fronte punctulata, stria marginali integra, basi continuata, recta; pronoto sparse punctulato, lateribus punctis grossis intermixtis, stria integra; elytris stria 1 integra, 2 postice punctiformi, 3 punctiformi, 4 basi cum suturali juncta, 5 punctiformi basi interrupta, subhumerali interna integra; propygidio pygidioque punctatis; prosterno basi impresso, stria marginali basi terminata; mesosterno sinuato marginatoque; metasterno utrinque parallelo-striato. L. $1\frac{1}{2}$ mill.

Hab. Ceylon.

This species is more parallel than most in the list; the metasternum has on each side a very clearly defined stria between

the middle and hind coxæ and is thus divided longitudinally into three parts. The external edge of the middle tibia is armed in the centre with an isolated but fine and distinct tooth. I took two examples in the touch-wood of an old tree in the Dikoya district in the spring of 1882; they were associated with a very pretty *Megapenthes*.

Triballus minimus, Rossi.—This common European species has a very wide range; I have a few specimens from Chefoo and about thirty examples from El Hahaz, taken by Dr. Millengen. All the Arabian examples are castaneous and correspond to a variety standing in several cabinets under the manuscript name of *castaneus*; but the Chinese specimens are typical.

Triballus tropicus, n. sp.

Ovalis, convexus, niger, nitidus, supra ocellato-punctatus et minute punctulatus; antennis tarsisque rufis; fronte subconcava sat dense punctulata ad oculos elevata; pronoto stria marginali antice late interrupta; elytris striis marginalibus integris; propygidio pygidioque sat dense punctulatis; prosterno utrinque striato, stria recta; mesosterno antice recto immarginato, margine laterali arcuato. L. 2 mill.

Hab. Singapore.

This species is allied to *kœnigius*, but it is much smaller, and the prosternal lateral stria is straight. The ocellated punctures in *tropicus* are scattered amongst a rather fine punctuation, the punctures disappearing gradually on the disk of the thorax and on the dorsal region behind the scutellum. The underside has an extremely fine rugosely punctate surface, with a scattered punctuation of a larger grade, and this punctuation is much larger on the first segment of the abdomen than on the metasternum. The stria dividing the mesosternum from the metasternum is crenellate, as in *colombius*, *kœnigius*, and others.

I found three or four examples in an old tree in the public garden at Singapore, 11th February, 1880.

Triballus montanus, n. sp.

Orbicularis, subconvexus, rufo-brunneus, nitidus, undique grosse sat dense punctatus; antennis pedibusque rufis; fronte subconcava, supra oculos valde elevata; pronoto stria laterali integra; elytris striis dorsalibus punctiformibus, brevibus; pygidio sparse punctulato apice lævi; meso- metasternoque ocellato-punctatis. L. 2 mill.

Hab. Dikoya, Ceylon.

The colour of this species separates it from all the others described. The punctures above are not distinctly ocellated, but those on the under surface and on the broad abdominal plate are clearly so. The elytra are clearly marginate, with a lateral stria running parallel to the margin, which leaves a fairly wide smooth interstice. The club of the antenna under a high power is composed apparently of two joints, and the ocellate punctures beneath are clearly seen under the microscope. *T. americanus* has a solid club.

I took about thirty specimens of this species from the burrow of a longicorn larva on the 25th January, 1882, in a large tree standing on Mr. Anderson's estate.

Saprinus lautus, Wollaston, 1869, *nec* Erichson, 1847 = *bicolor*, Fabr. Mr. Wollaston kindly sent me, in 1876, a type of his species from the Congo River, and this enabled me to decide the above synonymy; but it is only just now published.

Onthophilus tuberculisternum, n. sp.

Suborbicularis, supra gibbosus, niger, subopacus, griseo-setosus; antennis, scapo excepto, brunneis; pronoto 8-costato; elytris sutura, margine laterali, costisque 3, elevatis, interstitiis foveolatis; propygidio pygidioque rugosis; prosterno concavo, basi latiore, striis lateralibus integris; mesosterno medio tuberculato; metasterno medio longitudine sulcato. L. $1\frac{3}{5}$ mill.

Hab. Zanzibar (*Raffray*).

The thorax of this species differs much from that of the next in outline, as it is angulated as in *alternatus*. The sculpture of the head and the pygidium is much obscured by the setose growth upon them; the lateral striæ of the prosternum in this species and *bipartitus* are parallel to each other, and do not join anteriorly as in *9-costatus*. The mesosternum has a well-defined somewhat linear tubercle in the centre, and the metasternum is divided into two lobes by a line or sulcus down the middle, and is sparingly punctured, each puncture bearing a seta.

Onthophilus bipartitus, n. sp.

Orbicularis, convexus, niger, subopacus, setosus; fronte rugosa, margine elevata, medio subcarinata; pronoto parce punctato, margine laterali fortiter elevato; elytris sutura, margine laterali, costisque 6, elevatis, interstitiis bilineatim punctatis; propygidio pygidioque rugosis; prosterno subconcavo, stria laterali integra; mesosterno transverso, angulis antice linea impressis; metasterno margine laterali elevato, cum sulco transverso impresso. L. $1\frac{3}{4}$ mill.

Hab. Zanzibar (*Raffray*).

This species is fashioned above like a small specimen of 9-*costatus*, but the mesosternum is without foveæ and the metasternum has a transverse semicircular furrow which divides about one sixth of the surface from the posterior portion, and the suture between the latter and the first segment of the abdomen is indicated by a somewhat deep sulcus. The margin of the prosternal lobe is narrowly testaceous.

IDOLIA, nov. gen.

Corpus perconvexum, fere orbiculare, nigro-piceum, nitidum. Caput retractum; fronte triangulari, margine elevato; mandibulis robustis. Antennæ sub frontis margine insertæ, fossa nulla, scapo magno, funiculi articulo primo longiore, 3–8 æqualibus, clava abrupta ovali compressa 3- vel 4-articulata. Pronotum antice angustatum, basi latum, stria marginali integra. Scutellum triangulare. Elytris striis dorsalibus nullis. Prosternum latum, lobo latissimo, marginato, basi truncato. Mesosternum antice non sinuatum, a metasterno haud distinctum. Propygidium transversum perpendiculare; pygidium inferum obliquum. Pedes posteriores valde distantes; tibiis minute denticulatis.

This genus has some of the characteristics of *Sphærico-soma*; it differs in having a large scape to the antenna and in the great breadth of the lobe of the prosternum, which is without fossettes and widens out to the lateral edges of the thorax. Viewed from beneath the head cannot be seen when in a state of repose, and the anterior structure then presents the outline of a semicircle. Examined sideways there is seen a deep cut in the anterior angle of the thorax between the thoracic stria and the edge of the prosternal lobe for the reception of the antenna and part of the head, but this cavity cannot be seen from above. The antennæ are drawn in with the head, and during repose rest with it within the thorax. The pygidium is beneath as in *Notodoma*, is semicircular at the apex, and somewhat transverse at the base. The peculiar structure of the thorax and the absence of true antennal fossettes, and the construction of the meso- and metasterna without apparent sutures, seem to indicate that the genus is one of a low type, and it may be placed therefore after *Æletes*.

Idolia lævigata, n. sp.

Orbicularis, convexa, picea, nitida, pedibus antennisque dilutioribus; supra lævis; fronte subtilissime strigoso-rugosa, margine elevato; pronoto stria marginali integra, basi arcuato, antice utrinque obtuse angulato; elytris tenuissime marginatis; prosterno minute

strigoso-rugoso lateraliter striato; meso- metasternoque lævibus. L. 2 mill.

Hab. Honduras.

Distinguished from the following by characters given below; it is hardly necessary to say the rugosity of the under surface requires a microscope to discover it.

Idolia punctisternum, n. sp.

Orbicularis, convexa, brunneo-picea, nitida, undique sparse punctulata; pedibus antennisque brunneis, his clava testacea; fronte marginata; pronoto stria marginali integra, basi haud arcuato, antice utrinque acute angulato; elytris tenuissime marginatis; prosterno minute strigoso-rugoso, metasternoque sparse punctulatis. L. $2\frac{1}{8}$ mill.

Hab. Blumenau, Brazil.

This species is exceedingly like the foregoing, but may be at once recognized by the very distinct punctuation of the under surface, the punctures being placed with singular regularity at equal distances from each other. The base of the thorax is much less arcuate in *punctisternum* than in *lævigata*, and the anterior angles in *lævigata* are, comparatively speaking, obtuse.

XXII.—*Critical Notes on Dr. Augustus Gruber's "Contributions to the Knowledge of the* Amœbæ." By Surgeon-Major Wallich, M.D.

In the 'Annals' for February 1882 there appeared a translation of a paper by Dr. Gruber bearing the above title*, in which the author brought forward as new, and original on his part, certain facts and observations relating to the organization and vital phenomena in *Amœba*, which, as a matter of fact, had been discovered and published by me, also in the 'Annals,' upwards of twenty years ago. It so happened that owing to long-continued serious illness I was prevented from controverting Dr. Gruber's statements at the period referred to; and hence the matter became almost obliterated from my memory. To my surprise, however, the entire subject was reopened by the appearance, in the 'Journal of the Royal Microscopical Society' for April 1885, of a summarized version of a further paper by Dr. Gruber, in which most of his previously made statements were not only reiterated but con-

* Zeitschr. f. wiss. Zool. Band xxxi. pp. 459–470.

siderably amplified on the very points which call for refutation.

It may be within the recollection of some of the older readers of the 'Annals,' that in 1863 and 1864 a very detailed series of six papers by me, on the Amœban, Actinophryan, and Difflugian Rhizopods, was published in this Journal; the first of the series, which appeared in April 1863, setting forth the discovery, at Hampstead, of a till then unpublished and publicly unknown form of *Amœba*, to which I gave the name of *A. villosa*. This *Amœba* presented some most remarkable characters, and, being found in tolerable abundance, I was enabled to study it very minutely, and thus bring to light a large amount of information concerning the structural and functional characters of the Rhizopods in general that had not been previously available.

In the summary of Dr. Gruber's second paper (published in the Journ. Roy. Micr. Soc. for April 1885, pp. 260–61), *A. villosa* is referred to as "*Amœba villosa*, Leidy." This may, of course, be a mere clerical error on Dr. Gruber's part; but, if not so, it becomes all the more inexplicable, as Dr. Gruber, in his paper of 1882, makes such special reference to Professor Leidy's magnificent work on 'The Freshwater Rhizopods of North America' as to indicate that he (Dr. Gruber) was already critically acquainted with its contents. As a matter of fact, Prof. Leidy distinctly and prominently speaks of *Amœba villosa* as "*a large and remarkable species described by Dr. Wallich and discovered by him in England.*"

Unfortunately, Dr. Gruber's other inaccuracies of statement in reference to the *Amœbæ* do not admit of so ready explanation; for, apart from the obligation every writer on scientific subjects is under of making himself acquainted with the discoveries of those who have preceded him in any special line of research, prior to sending forth any views of his own as new and original, it is an unquestionable fact that a full list of all my papers on the Amœban Rhizopods up to date, together with extracts from the papers themselves on the very subjects so much more recently dealt with by Dr. Gruber, was to be found in Prof. Leidy's work. But, be that as it may, I shall now proceed to place the facts of the case in a sufficiently clear light to prove beyond question on which side priority of observation as well as of publication rests. This I will endeavour to do as briefly as I can compatibly with due justice to Dr. Gruber as well as to myself. But, in a matter of this kind, just conclusions can only be drawn from the actually published records of both parties. I propose therefore to supply, without comment of any sort, first, a

few brief extracts from Prof. Leidy's work already referred to, and from a paper of Prof. Martin Duncan, showing how far these two eminent authorities were acquainted with my writings of 1863–64: secondly, to furnish such extracts from Dr. Gruber's two papers as may suffice to indicate clearly those observations and statements of his that I desire to criticize or controvert; thirdly, to furnish such extracts from my own papers in the 'Annals,' above referred to, as may be needed to prove that my claim to priority is literally and fully substantiated; and, lastly, to conclude with some general observations.

PROF. LEIDY.—"It appears from the researches, especially of British authorities such as Carpenter, Williamson, Wallich, Brady, Parker, and Jones, that the members of this class are infinitely variable, and that, indeed, no absolute distinctions of species and genera exist, such as appear more definitely to characterize the higher forms of animal life. My own investigations rather confirm this view, and under the circumstances we can only regard the more conspicuous forms as so many nominal species, in likeness with the species of higher organic forms more or less intimately related, or by intermediate forms or varieties merging into one another." —*Freshwater Rhizopods of North America* (Washington, 1879), p. 6.

"Dr. Wallich regards the endosarc and ectosarc as temporarily distinct portions of the sarcode, mutually convertible into one another. The ectosarc becomes differentiated from the endosarc by contact with the outside medium in which the animal lives, and from time to time reverts again to the condition of the more fluent endosarc within. From this view, as intimated by Dr. Wallich himself, the ectosarc is due to a temporary and partial coagulation of the endosarc coming into contact with the water in which the animal lives, and again reverts to the condition of the more fluent endosarc as it retreats to the mass of the latter within the body. This process reminds one of the cooling of a molten mass of metal at the sides of a crucible, and the melting away of the crust as it is stirred from the sides of the molten mass within."—*Op. cit.* p. 24.

"Dr. Wallich considers the so-called vacuoles or food-vacuoles not in the light of mere spaces, but as temporary vesicles of ectosarc, due to inversion of portions of the exterior ectosarc at the time of the inception of the food, or to the contact of water with portions of the endosarc."—*Ibid.* p. 26.

"While there is no absolute distinction between the ectosarc and endosarc" (reference here made to *A. Proteus*), "the two being continuations of the same protoplasmic mass,

in the movements of the animal the endosarc appears to flow within walls, more or less thick, formed by the ectosarc. With the exhaustion of the endosarc from behind, the including ectosarc contracts and melts away into the advancing portion of the body."—*Op. cit.* p. 38.

"In the taking of food he" (Dr. Wallich) "supposes that each portion when swallowed becomes enveloped with a film of ectosarc, which forms a vesicle enclosing the food and water-drop in the interior of the endosarc. As the food undergoes digestion, and the water, altered in condition, is imbibed from the vacuoles into the contiguous endosarc, the vesicles of ectosarc which contained the food and water undergo resolution into endosarc."—*Op. cit.* pp. 43–4.

"Amœba villosa. *Amœba,* Wallich, Ann. & Mag. Nat. Hist. 1863, vol. xi. pl. viii. p. 287. *Amœba villosa,* Wallich, *ibid.* p. 366, pl. ix. p. 434, pl. x. figs. 5–9. Duncan, Pop. Sci. Rev. 1877, p. 217, pl. vi. figs. 38–40.

"Size, to $\frac{1}{50}$th of an inch (Wallich).

"Amœba villosa, a large and remarkable species, described by Dr. Wallich, was discovered by him in England."—*Op. cit.* p. 63.

"Dr. Wallich's remarks concerning the movements of *Amœba villosa* apply equally to those of the form under consideration" (meaning *Pelomyxa villosa,* Leidy). "He says that 'the rush of granules of the sarcode does not follow upon a previous contractile effort exercised at the posterior portion. As the animal progresses, occasionally altering its course, there are periods during which perfect quiescence is maintained by the granules; and the rush or flow of these seems to take place, as it were, to fill up the vacuum engendered by the sudden projection of a portion of the ectosarc."—*Ann. & Mag. Nat. Hist.* 1863, xi. p. 369; *op. cit.* p. 75.

"Dr. Wallich describes a conspicuous nucleus and an equally conspicuous contractile vesicle as present in *Amœba villosa,* having the same essential characters and holding the same habitual positions as in *Amœba proteus.* In the figures accompanying Dr. Wallich's memoir the single large nucleus and the large contractile vesicle, or, in its place, several smaller ones, are the most striking features of the creature."—*Op. cit.* p. 80.

Prof. Martin Duncan ("Studies among the *Amœbæ*"). —"All that has been noticed in these studies will be found somewhere or other, and I found it most interesting and instructive to study the work of Dr. Wallich in the Ann. & Mag. Nat. Hist. for 1863. There the hairy *Amœba* is

admirably described and christened *Amœba villosa*, and all its oddities are explained; there the reciprocal nature of the endosarc and diaphane" (a name given to the ectosarc by Carter), "the nature of the nucleus, and the method of its subdivision, and, indeed, the exact morphology of the *Amœbœ*, is given to perfection. . . . One thing has struck me, and that is that there are two species of *Amœba* only, and not a score. There is *A. villosa*, which is a really crowned head; then there is the other, which, according to locality, time, season, food, and the eyes of the observer, changes its general shape and receives many names, and is called *Amœba princeps*. It ought to be *A. communis*, as it is plebeian to the regal *villosa*."—*Pop. Sci. Rev.* 1877, p. 217.

Dr. Gruber ("Contributions to the Knowledge of the *Amœbœ*").—"Auerbach, as is well known, starting from the assumption that a membranous boundary was a necessary attribute of a cell, set up a theory, quite compatible under the circumstances of the time, according to which the *Amœbœ* also, as unicellular creatures, had a membranous envelope. This opinion was refuted by subsequent naturalists, and it was Greeff principally who gave a more correct interpretation of Auerbach's observation."—Translated version of Dr. Gruber's paper, *Ann. & Mag. Nat. Hist.* Feb. 1882, p. 106.

"The melting of the fine cortical layer into the broad clear border does not take place with equal rapidity at all points, so that a part of the *Amœba* often appears sharply limited, whilst another is already surrounded by a clear space. . . . In this way *Amœba diffluens* can continuously change its aspect completely in one or other of the modes described. Upon what law this power depends cannot be stated definitely; very probably, however, different conditions of pressure come into play in the matter. With a centripetal force acting uniformly upon the whole periphery, the more fluid parts of the protoplasm are all pressed into the interior, and only the narrow membranaceous boundary remains. *This acquires a firmer consistence by contact with water*, and therefore at the points where the pseudopodia issue it is pushed aside by the latter. If the general pressure ceases, the more fluid constituents again come forth from the interior, *dissolve the solidified cortical layer*, and form the clear border. The best illustration of the process is furnished by those cases in which a slow flowing forward of the *Amœba* in one direction is taking place. On the advancing side the fluid constituents are pushed on in front; *here all pressure has ceased, whilst it acts on the opposite side, where, accordingly, the cortical contours are quite distinctly to be seen*."—*Ann. & Mag. Nat. Hist.* Feb. 1882, pp. 112–113.

"The pushing forward of the more fluid constituents is effected by the action of a pressure on the opposite side; *this is produced by the extremest layer at this part* acquiring a tougher consistency by extraction of water. The latter is widened during the flow of the *Amœba* at the posterior end by all sorts of processes, lobes, hairs, &c., which often give the *Amœba* a peculiar aspect, and *have led* to the establishment of distinct species. The sarcode here becomes so tough that as the *Amœba* hastens forward it *draws into threads*, if the expression may be allowed. If the direction of movement is reversed, the previous posterior extremity begins to flow, *and the most tenacious protoplasm occurs on the opposite side.*"—*Ibid.* p. 115.

"Gruber is of opinion that the discrimination of zones of different kinds of protoplasm is due to a misunderstanding; the Amœbic body always consists of a single mass of protoplasm in which the various contents are suspended; *when the plasma is fluid the contents are well distributed, but when it is firmer they do not mix so easily mith it; this is the cause of the appearance of a hyaline ectoplasm and a granular endoplasm. The only differentiation in the body of an* Amœba *obtains at the outermost periphery, where the protoplasm, clearly from contact with water, is converted into an invisible cuticula-like layer, which disappears during the outpushing of the pseudopodia, and can be remade.*"—Epitome of Dr. Gruber's paper in the Journ. Roy. Micr. Soc. for April 1884 (p. 260), the paper itself having been published in Zeitschr. f. wiss. Zool. xli. 1884, pp. 186–225.

"The diagnosis of an *Amœba* must be based on its average size, the consistency of the protoplasm, and the movements therein conditioned, as well as on the characters of its contents, such as vacuoles, granules, crystals, but chiefly on the number, size, and structure of the nuclei. Five of the species described in the present essay are multinuclear, and it is proved how definitely the nuclei are distinguished from one another, and with what certainty one can conclude from external characters on the structure of the nucleus, and *vice versâ.* Thence results the remarkable fact that two very similar species of *Amœba* may have very differently formed nuclei, and that in forms which are externally very different the nuclei may be quite similar. In any case the number of the different forms of nuclei is much more important than has hitherto been supposed."—*Ibid.* pp. 260–1.

The species lately described by Leidy and found by Gruber in Europe confirm the doctrine that the freshwater Rhizopods are cosmopolitan organisms.

My own Papers of 1863–4.—"The Hampstead form" (*Amœba villosa*, so named in the paper succeeding that from which the present extract is taken) "corresponds in every important particular with one found by me in Lower Bengal in 1856, in which the villous portion of the ectosarc constitutes a means of permanent attachment to foreign bodies, such as Confervæ or the like; and the animal appears to be normally sessile in its habits."—*Ann. & Mag. Nat. Hist.* April 1863, p. 290 *.

"When evaporation of the water" (in my aquarium) "had gone on to a greater extent, the entire granular mass referred to became segregated, as if by a process of segmentation, *into numerous distinct nuclei*, amongst which a true nucleus was not recognizable as a separate or different structure. These multiple nuclei, varying in number from five to about a dozen, were contained in no separate cavity or cavities, but occupied the position previously occupied by the single large granular mass. In the specimen exhibiting this structure the animal seemed inclined to assume an encysted form, motion being almost totally suspended."—*Ann. & Mag. Nat. Hist.* May 1863, p. 368, pl. ix. fig. 5.

"Another fact is deducible from the appearances presented by the sarcode-substance of the largest of these *Amœbæ*. The rush of granules does not follow upon a previous contractile effort exercised at the posterior portion. As the animal progresses, occasionally altering its course, there are periods during which perfect quiescence is maintained by the granules; and the rush or flow of these seems to take place, as it were, to fill up the vacuum engendered by the sudden projection of a portion of the ectosarc in the shape of a pseudopodium. Hence it would appear that motion is dependent on the contractile power of the external sarcode-layer, and that the endosarc only passively participates in it. If this view is correct, it involves a very important consideration; for it proves that the old German doctrine of a "primary contractile mucus" is essentially correct, and that the circulation is not dependent, even in part, on the alternate expansion and collapse of the contractile vesicle. Further than this, it affords the strongest confirmation of the high degree of differentiation existing between the endosarc and ectosarc of the Amœban group.

"The mysterious faculty resident in the latter portion of the

* No description of this Bengal *Amœba* had been published by me; but, as stated in a footnote to the above extract, in my 'North Atlantic Sea-bed,' published in 1860, pl. iv. figs. 13 and 14, *a*, *b*, this remarkable form is drawn in its occasional free and also in its sessile state.

structure, of forming extempore orifices for the inception or extrusion of food-particles, &c., may be witnessed in these specimens in a very singular manner, and one which, as far as I am aware, has not hitherto attracted attention. I allude to the projection of the ectosarc from some area of the general surface in the form of a hemispherical mass with a broad base, only a very small portion of the original contour line seeming to give way at first, so as to admit of the passage of the endosarc and other granular contents into the newly projected part, but its entire floor appearing to be gradually dissolved, as it were, and free communication between the main body and the new pseudopodial cavity not being established until the completion of this process. Whilst it is progressing, the endosarc-granules seem to rush round a corner into the cavity, the corner gradually receding, so to speak, and ultimately being altogether obliterated.

"From these facts it is obvious that the ectosarc and endosarc *are not permanent portions of the Protean structure, but mutually convertible one into the other; and that it is an essential feature of sarcode that, whilst the outer layer for the time being becomes*, ipso facto, *instantaneously differentiated into ectosarc, the same layer reverts to the condition of endosarc under the circumstances just described.* In the latter part of the process, that is, the reversion to the condition of endosarc, the action is by no means so instantaneous as when the converse takes place. In the Actinophryans both processes are, comparatively speaking, slow."—*Ann. & Mag. Nat. Hist.* May 1863, pp. 369, 370.

"In my experience the contractile vesicle does not make its appearance either in the lowest order" (according to my classification), "viz. the HERPNEMATA, or second order of PROTODERMATA, but occurs for the first time in the third order, viz. the PROTEINA, in which I associate the Actinophryna, Lagenidæ, and AMŒBINA. In the third order both nucleus and contractile vesicle are invariably present, though naturally difficult of detection in the testaceous genera. The latter organ, however, in so far as my experience of living representatives of nearly every important form enables me to arrive at a correct opinion on the subject, ought not to be regarded as a definite-walled contractile sac, distinct in composition from the rest of the protoplasmic matter, but simply as a specialized vacuolar cavity, *formed out of a portion of ectosarc.*" —*Ann. & Mag. Nat. Hist.* June 1863, p. 439.

"In *Amœba*, the true ectosarc appears to be nothing more than the outer layer of sarcode (for the time being) consolidated by contact with external influences, its thickness being dependent on the length of time these influences continue

without interruption to act upon it; whilst the consolidation referred to is greater at the immediate surface, and gradually diminishes in extent, and finally fades away from thence inwards . . . In the nearly quiescent condition of *Amœba*, when the outline becomes more or less spherical, the greater amount of consolidation of the exterior layer is shown by *the hyaline margin becoming broader, and the whole of the contents being, consequently, made to recede towards the centre* . . . . If not convertible into each other as I have described, how is it that an *Amœba* may be lacerated so as to form two or more portions, each of which immediately presents, at every portion of its surface, the same appearance as existed prior to laceration, not necessarily by the folding together and union of the torn margins, *but by the immediate development of* ectosarc upon the torn surface? Let the process be called instantaneous cicatrization, or what else we will, the phenomenon remains the same."—*Ann. & Mag. Nat. Hist.* Aug. 1863, pp. 129, 130.

"The conversion of endosarc into ectosarc, I *regard as analogous in its character, if not identical, with coagulation*, the effect produced by the mere contact of sarcode with the medium in which it resides, *while the converse process constitutes an inherent* vital function of the animal protoplasm. Should this view be admissible, we have presented to us a phenomenon bearing in the most important manner on the general question of development, and one which, I venture to affirm, is far more largely engaged in the production of specific type, not only amongst the lower, but also the higher orders of being, than we have heretofore been disposed to allow. I allude to the reciprocal action of physical and vital forces."—*Ann. & Mag, Nat. Hist.* Aug. 1863, pp. 147, 148.

"I am more than ever convinced that this" (the pseudocyclosis in *Amœba*) "is *not a* vital act, but *a secondary, and merely a mechanical effect consequent on the* inherent vital *contractility* of sarcode. It is only necessary to watch a specimen of *Amœba* carefully, *to become convinced that the appearance of a returning, as well as an advancing, stream of granules is illusory.* The stream, it will be observed, is invariably in the direction of the preponderating pseudopodial projections. The particles simply flow along with the advancing rush of granules. *There is no return stream, but the semblance of one is engendered by one layer of particles remaining at rest while another is flowing past them.* In short, the effect is similar to that which would be produced were a transparent bladder or sac of caoutchouc, containing granular bodies of greater specific gravity than the viscid fluid within which they are suspended, to be rolled along a plane surface.

In such a case it is obvious that only the granules on the upper or free aspect of the sac would be carried onwards, that, *having arrived at the most advanced point, they would be, as it were, deposited, and remain stationary, as would also that portion of the sac on which they rested, until the rest of the mass should have again flowed over them, causing them now to appear at the posterior extremity, when they would once more be urged on as before.*

"The same explanation will, I think, be found to hold good in some families, as, for instance, the Foraminifera. The essential attributes of sarcode, extensibility and contractility, coupled with the polymorphism evident on every example in which definite form is not partially maintained by the presence of a shell or test, necessarily involve the power of retracting as well as projecting these processes, whereas the tenacity of the substance is not such that a pseudopodium once projected can be retracted towards the body in the same way that a rope thrown forward from a given point can be hauled in again, inch by inch. In the pseudopodium of *Amœba*, as also in the attenuated filaments of the Foraminifera, or the still more subtle filaments of *Acanthometra* or *Euglypha*, the process is the same, and is brought about by the reciprocal outward and inward flow of the sarcode substance; and thus the granular particles are merely the passive exponents of a vital force which exists quite independently of them. Hence, with all deference to such an authority as Prof. Schultze, I would still regard the circulation of granules in the Rhizopods as a PSEUDOCYCLOSIS, analogous, I grant, in appearance but not in origin to the cyclosis observable in certain vegetable cells, as, for example, *Tradescantia*."—*Ann. & Mag. Nat. Hist.* Nov. 1863, pp. 331, 332.

"In the *Amœban* Rhizopods in general, without any exception, whether naked or testaceous, their protoplasmic substance is differentiated into an anterior and posterior portion."—*Ann. & Mag. Nat. Hist.* Nov. 1863, p. 333.

"Now contractility is the inherent property of protoplasm, but not till it has become consolidated to a certain point; and this consolidation does not take place within the substance itself, but only at the surface *. If we take the example of an ordinary contractile substance the process is to all intents the same. Thus caoutchouc, when oozing from the parent tree, is not contractile but a semifluid viscid mass. So is the sarcode

* The formation within the general mass of the body-substance of ectosarc in the case of vacuolar cavities, or the contractile vesicle or vesicles, as will be seen in a former extract, does not constitute an intrinsically originating process, but dependent, as in the true outer ectosarc layer, on the presence of, or contact with water.

in the interior of *Amœba.* But as soon as the action of the atmosphere causes coagulation or consolidation of the tears of caoutchouc, the innate contractility becomes at once manifest. A precisely similar effect is produced by the contact between endosarc and water. In the case of caoutchouc the consolidation once established there is no return to the previous condition. Why? *Simply because its vitality ceased with its extrusion from the tree.* But even here the analogy is not altogether destroyed; for the contractility" (elasticity) "may be materially diminished by heat, and the mass may again become an adhesive semifluid, capable of permanently assuming any figure. Yet, on the reduction of the temperature, consolidation again takes place, and, with it, the mass resumes its elasticity. So that, assuming sarcode to be endowed with vitality—a fact, I presume, not admitting of denial—and also that it is contractile, we have not only all the conditions that place the phenomena observed in the light of simple cause and effect, but it appears to me absolutely impossible to account for them in any other way."—*Ann. & Mag. Nat. Hist.* Dec. 1863, pp. 455–6.

General Remarks on the Foregoing Extracts.—Concerning Dr. Gruber's "Diagnosis in *Amœba*" *, I have to observe, that in my experience the number of nuclei may vary almost to any moderate extent, in certain forms and under certain conditions. This fact becomes very obvious when the same forms are observed, in the same localities, for several successive years. To say that, because multiple nuclei occur in forms which present no other—or, at all events, no other important—characters which distinguish them from those possessing only single nuclei, they are *therefore* different species, is scarcely a legitimate conclusion. For we find it very commonly negatived *in toto* in the case of *Amœba* (as already shown, *antè*), as well as in *Arcella vulgaris* and other forms. When this *Arcella* occurs in anything like abundance, and its tests are neither too old nor too obscured by dirt, we may constantly see several distinct nuclei within the body-substance of the animal. In one example I observed no less than six. The following memorandum in one of my note-books relates to this specimen:—"Oct. 21, 1864. Found a large *Arcella vulgaris*, D $\frac{1}{185}$! with nine contractile vesicles, all peripheral and acting energetically, but of course not synchronously. Average interval between diastole and systole, as nearly as I could estimate, about four minutes. There were on this specimen *six distinct nuclei of the ordinary size.*"

Dr. Gruber's Remarks as to PRESSURE *being the Cause of the Movement of Granular Particles &c. in the Body-substance*

* See *antè* p. 220.

of Amœba.—In one place, as will have been seen, Dr. Gruber expresses himself somewhat doubtfully on this subject. He says: "Upon what law this power depends cannot be stated definitely; very probably, however, different conditions of pressure come into play in the matter." In a later part of his remarks his doubts would seem to have already been resolved; for he there states unconditionally that "the pushing forward of the more fluid constituents is effected by the action of a pressure on the opposite side," &c. I confess my inability to understand in what way "different conditions of pressure" can be developed, if such pressure be not an inherent vital attribute of the sarcode-body itself, manifesting itself by the production within its own substance of contractility and extensibility. These effects are manifest in the *Amœbæ* in a very high degree, and we know well enough that no pressure of any ordinary kind could actually compress a fluid or semifluid substance like sarcode, even in the slightest degree.

But, without any argument derivable from hydraulics or hydrostatics, the vital, and, in this sense exceptional, character of the force that causes a pseudopodium to be projected, and, still more notably, a pseudopodium to be retracted, appears to me to be conclusively demonstrated by what happens during the change from the extension of a pseudopodium in one direction, to its retraction in the opposite direction. Assuming that due precautions are observed to prevent illusory effects, it will be seen that whereas the *commencement* of the motion of the granules (which is the initiatory step in the projection of a pseudopodium) is distinctly observable at the *most advanced* portion of the mass which is going to constitute such pseudopodium, the *commencement* of the *retrograde* movement of the particles is to be seen taking place at that portion of the pseudopodium which constitutes, *not* its apex, but its base, each consecutive tier of granules pursuing the same order until all are again reintroduced into the general mass. In short, the order pursued by the granular units in the projection and retraction of a pseudopodium is identical with that pursued by a mass of human units when streaming into an enclosed space through a single door, the human units in front of the mass being naturally the first to flow in, even when those in the rear have the civility not to exert pressure on them; whereas in flowing out, the units who constituted the rear would be the first to commence the retrograde movement.

But to carry the case a point still further. Assuming, for argument's sake, that "pressure" acts, as urged by Dr. Gruber, by "extracting water" from a given portion of the sarcode-body of *Amœba*, the explanation would in no wise account for the *collapse* as well as the inflation with fluid of

the contractile vesicle. If effective in *forming*, it could not by any stretch of the imagination be truly regarded as the efficient cause in the almost instantaneous reflux into the mass of the body-substance of the ectosarc constituting the contractile vesicle. Besides, according to Dr. Gruber, the pressure he refers to is exercised at the *posterior* aspect of the *Amœba*, and since the contractile vesicle almost always discharges itself in that region, it would be doing so in the teeth of the very force which is, at the very same time, exerting itself in projecting pseudopodia in the opposite direction to the contractile vesicle.

Having for the present brought these observations to a close, it only remains for me to assure Dr. Gruber that I am extremely glad to find that so able a writer and thinker has been led, although by a different route, to conclusions concerning the relations between endosarc and ectosarc, and the phenomenon of pseudocyclosis, similar to those arrived at by me so many years previously.

BIBLIOGRAPHICAL NOTICES.

Australian Museum. Catalogue of the Australian Hydroid Zoophytes. By W. M. Bale. Sydney: 1884.

The publication of the 'Catalogue of the Australian Hydroid Zoophytes,' printed by order of the Trustees of the Australian Museum, has supplied a want which has long been felt of a detailed and critical account of the various species of Hydroids which have been described from the Australian seas. Many of the older species are known only by very brief descriptions, which, however admirable at the time at which they were framed, have been rendered, more especially in the absence of illustrative figures, altogether indefinite, owing to the numerous allied forms which have since come to light.

The present Catalogue contains, besides the description of a large number of new or lately known forms, redescriptions or amended descriptions of many of these older species in those cases where their identification has been possible, while supplementary characters and original remarks, often with considerable detail, on many of the genera and species which are described give additional value to the work.

A special feature of the Catalogue is the large number of figures which are given, and which, with but few exceptions, are from original drawings.

It will thus be seen that the work is a valuable contribution to the literature on zoophytology, and will form an important landmark in the history of the Australian zoophytes.

For the general student the usefulness of the Catalogue is greatly increased by the succinct account, which is given at the beginning, of the organization of the Hydroida, an account which, as is stated, is mainly drawn from the Rev. Thomas Hincks's 'History of the British Hydroid Zoophytes,' on the plan of which work the present Catalogue is largely modelled. Many interesting facts, based on the author's own observations, are incorporated with this portion of the Catalogue, such, for example, as the occurrence in species of *Sertularia* (*S. crenata*) of an intrathecal ridge, a structure chiefly characteristic of the Aglaophenian section of the Plumularidæ; and the extreme variability in the nature and position of the external apertures in the sarcothecæ of *Aglaophenia*.

Though the introductory *résumé* of the chief features of hydroid organization was by no means intended to be exhaustive, yet it is to be regretted that no mention has been made by Mr. Bale of the neuromuscular or epidermo-muscular cells in the account of the structure of *Hydra* on the one hand, or of the nervous system of the Medusa-persons on the other.

As regards the distribution of the species, which have hitherto been obtained almost entirely from the eastern part of the continent, two distinct areas exist, one on the north-east, the other on the south-east, in each of which the forms differ almost entirely from each other, though mixing to some extent in the intermediate districts.

Thirty well-marked species occur only in the north-east region, though four of these are found also in districts north of Australia; and eighty species are found only in the south-east region, many of them ranging to Africa, Europe, and America, and occurring more abundantly in New Zealand, with the Hydroid fauna of which that of the south-east region is very closely allied. Two species only, *Idia pristis* and *Plumularia campanula*, occur in both regions. No genera are peculiar to the northern region; but *Lineolaria* with two species, *Halicornopsis*, *Eucopella*, and *Ceratella* with one each, are found only in the southern district, together with that section of *Plumularia* in which only one hydrotheca is borne on each pinna, of which section one of the species, *P. obliqua*, occurs also in England and Tasmania.

A list is given of the principal works in which Australian species have been described, together with a more detailed list of the more important general works on the Hydroida which are quoted or alluded to in the text.

The systematic treatment of the genera and species forms the greater bulk of the volume; and an idea may be formed of the contribution which Mr. Bale has more directly made to the knowledge of the hydroid fauna of the Australian seas, when it is noted that, out of about 125 well-defined species which are recorded, not fewer than 47 have been made known by him.

Counting the undetermined species of *Eudendrium* and *Halecium*, 144 species in all are described, of which about 16 are regarded as doubtful. One species of the genus *Hydra* is recorded, for which the order Eleutheroblastea, following the older classification, has

been retained distinct from the Gymnoblastea. Seven species representing six genera, *Tubularia* with two species, and *Tibiana*, *Eudendrium*, *Pennaria*, *Ceratella*, and *Dehitella* with one each, belong to the Gymnoblastea; while the other species, representing seventeen genera, are forms of the Calyptoblastea, namely:—

Campanularia	12 species.	*Pasythea*	2 species.
Obelia	1 "	*Idia*	1 "
Eucopella	1 "	*Thuiaria*	3 "
Lineolaria	2 "	*Plumularia*	22 "
Lafoëa	1 "	*Antennularia*	2 "
Halecium	1 "	*Aglaophenia*	22 "
Sertularia	40 "	*Halicornaria*	10 "
Diphasia	5 "	*Halicornopsis*	1 "
Sertularella	10 "		

Among the new species which have been described in the Catalogue is one of the singular genus *Lineolaria* (consisting now of two species), which was originally founded by the Rev. Thomas Hincks for a most curious Australian hydroid from Port Phillip, and for which Prof. Allman has since constituted a new family.

In the definition of the genus *Sertularia* Mr. Bale insists on the paired condition of the hydrothecæ as being an essential character which serves as an important distinction between this genus and its allies *Sertularella* and *Thuiaria*; and he points out that the genus *Desmoscyphus*, Allman, is not really distinct from *Sertularia*.

A most remarkable variety of the *Sertularia unguiculata*, Busk, which throws considerable light on the affinities of the genus, is described, in which not only do some pinnæ bear as many as twenty-four pairs of hydrothecæ on the longest internodes, closely adnate throughout the greater part of their length, while towards the end of the pinnæ the ordinary Sertularian type is found, but also on some of the pinnæ there is present a third series of hydrothecæ running for some distance along the front of the first internode.

Very valuable critical remarks are made on the definition of the genus *Thuiaria*. Formerly the adnate condition of the hydrothecæ was a sufficient distinction from *Sertularia*; but this has had to be given up with the increase of our knowledge of their forms, and the distinction was based by Prof. Allman on the nature of the jointing of the hydrocaulus and the number of hydrothecæ on the internode. Mr. Bale points out that this again must be abandoned, and that the real distinction is to be found in the fact, that while in *Sertularia* the hydrothecæ are arranged in pairs, in *Thuiaria* they form two series, those on opposite sides of the hydrocaulus having no special relation to each other.

Correspondingly valuable remarks are made on various points under the genera *Plumularia*, *Aglaophenia*, and *Halicornaria*; but it is to be regretted that the essential characteristics of *Plumularia* and *Antennularia* have not been subjected to the same critical examination which marks many of the other genera.

In this short notice it has been impossible to do full justice to Mr. Bale's admirable work; and the reader must be referred to the work itself for further information.

Elementary Text-Book of Entomology. By W. F. Kirby. London: Sonnenschein and Co., 1885.

The title of this book is somewhat misleading, which was probably not the author's fault, as his object was to furnish "a portable Hand-book, freely illustrated, in which a number of the most typical and remarkable insects of all parts of the world should be popularly described and figured." To this end not less than eighty-seven plates of woodcuts containing 650 figures, of which more than half are devoted to Lepidoptera, are given. Woodcuts are not well adapted for portraying insects; but, on the whole, the species are fairly recognizable, a few, like *Batocera rubus*, *Truxalis nasuta*, *Calepteryx virgo*, and two or three others, excepted. Most of the insects figured are common in collections; and this is an advantage as enabling the beginner to name his species, always a great desideratum.

Mr. Kirby has given short descriptions of most of the families, and often of some of the species, as well as of their habits and economy; considering the necessarily limited character of the work, this has been exceedingly well done.

As to the relationship of the Collembola and Thysanura, we should prefer to follow Sir J. Lubbock, who has made them a special study, and regard them not as "true insects" rather than as Neuroptera. The Mallophaga also would be better placed with the Hemiptera, as Gerstäcker, Claus, and others have placed them. But may we ask why he has invariably commenced the specific names with a capital?

It is, we think, very unfortunate that Mr. Kirby should have reverted to the old name of Locustidæ for the Gryllidæ, and that he should have adopted *Acheta* for the classical *Gryllus*. The former name, a section of the genus *Gryllus* of Linnæus (by whom it was first used, and not by Fabricius), should, by the law of priority, revert to the mole-cricket (*Gryllotalpa*). It is perhaps quite as unfortunate that he, in following the vicious practice of the Munich Catalogue, which pays no attention to names previously used, provided that they are not used for Coleoptera, should have adopted the generic name of the kangaroo for the harlequin beetle that forms his frontispiece.

Mr. Kirby's volume will be very useful to those who only require a general idea of insect-forms; to the traveller, who cannot carry many books with him, it will give a clue to the systematic position of almost any insect he may acquire.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

April 29, 1885.—Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., President, in the Chair.

The following communication was read:—

"On the Structure of the Ambulacra of some Fossil Genera and Species of Regular Echinoidea." By Prof. P. Martin Duncan, M.B. (Lond.), F.R.S., V.P. Linn. Soc., F.G.S.

After noticing the general knowledge which exists about the

structure of the ambulacra in the Cidaridæ and the elaborate investigations of Lovén on the Triplechinidæ, the author brought before the Society the results of his own work with and without the cooperation of his fellow-worker in the description of the Echinoidea of Sind, Mr. Percy Sladen, F.G.S., and which referred to the Diadematidæ and the Arbaciadæ of the recent faunas. Starting with the knowledge of the construction of the modern Diadematidæ, the author investigated the genera *Hemipedina*, *Pseudodiadema*, *Pedina*, *Hemicidaris*, *Diplopodia*, and *Cyphosoma*. The necessity for the reestablishment of the genus *Diplopodia* was shown, and a new genus, *Plesiodiadema*, was founded. *Pseudodiadema*, shorn of the forms included in these genera, remains, and differs more from *Diadema* than has been believed. The method of the growth of the great plates of *Hemicidaris* was explained, and the comparison between the peristomial plates of some of the Diadematidæ and the universal structure of the ambulacral plates in *Pedina* was made. The author considered that there are six types of ambulacra in the regular Echinoidea, so far as the group has been investigated, there still remaining much to be done. These types are the Cidaroid, Diadematoid, Arbacioid, Echinoid, Cyphosomoid, and Diplopodous. In conclusion the succession in time of the structures which characterize these types was considered.

May 13, 1885.—Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., President, in the Chair.

The following communication was read:—

"On the Ostracoda of the Purbeck Formation; with Notes on the Wealden Species." By Prof. T. Rupert Jones, F.R.S., F.G.S.

The author stated that in 1850 Prof. Edward Forbes had determined the tripartite division of the Purbeck beds, after working at the sections in the south of England with Mr. Bristow, and had intimated that several species of the so-called "Cypridæ" aided him in arriving at this result. He did not, however, publish any account of the several forms, and we know of his intended species only (1) by his having pointed them out to his friends Messrs. Bristow, Osmond Fisher, and W. Cunnington; (2) by a letter to Mr. Bristow in 1851 and one to the Author in 1854; (3) by some diagrams in the Museum of Practical Geology; and (4) by some rough woodcuts in Sir Charles Lyell's 'Manual of Elementary Geology,' 5th edit. (1855). Having a large collection of Purbeck and Wealden Entomostraca, the author has endeavoured to decide which were E. Forbes's species; and from a careful examination of the collections in the Geological Society's Museum, the Museum of Practical Geology, and the British Museum, in which he has been greatly assisted by Mr. E. T. Newton, F.G.S., and Mr. C. D. Sherborn, he has arrived at the definite conclusion that there are fourteen species in E. Forbes's three divisions of the Purbeck series. Five of them (*Cypris purbeckensis*, *Candona bononiensis*, *C. ansata*, *Cythere Blakei*, and *C.*

retirugata) occur only in the Lower Purbeck; and of the others, six occur in both the Middle and Upper. Of the fourteen, five (*Cypridea valdensis*, very rare in the Purbeck, *C. tuberculata*, *C. Dunkeri*, *Cyprione Bristovii*, and *Darwinula leguminella*) go up into the Wealden from the Middle and Upper divisions only. *Cypridea punctata* for the Upper, *C. granulosa* (*fasciculata*) for the Middle, and *Cypris purbeckensis* for the Lower Purbeck, seem to be always characteristic.

MISCELLANEOUS.

On a new State of Reticularian Rhizopods. By M. de Folin.

Among the forms of Reticularian Rhizopoda belonging to the tribe Nuda, that is to say those which live without envelopes, we have distinguished some remarkable examples formed by a sort of membranous sheath, developing in tubes filled with sarcode. These tubes present numerous branches, the interlacings of which cross one another upon several planes, giving to the whole the aspect of an irregular network. These form the genus *Pseudarkys*. We find them sheltered in all the cavities presented by old perforated shells; and from the mode in which they fill these and the multiplicity of branches of which they are composed, it might be supposed that they had themselves hollowed out their shelters. Some observations have shown us that this is not the case. One most significant circumstance has just dissipated all doubts upon this point, namely, the occurrence of a specimen of *Pseudarkys* inhabiting the cells of a *Dentalina* and adopting their form. It was very easily distinguished through the semitransparent test, and in this position it presented a clear proof that the organism certainly belonged to the tribe Nuda. At its birth it had introduced itself into the asylum, and in growing it had moulded its system of ramification upon the inner walls.

The same animal, varying in dimensions according to the retreats in which it had taken up its abode, was met with in a considerable number of the dredgings of the 'Travailleur;' but the species seems to remain the same. One of those of the 'Talisman,' on the other hand, furnished us with an example of an alteration in the mode of sheltering itself adopted by this organism. The branching, instead of penetrating into a ready-made retreat, surrounded itself with corpuscles, and especially with *Globigerinæ*, which were very abundant on the bottom on which it lived. In some cases, the envelope not being completed, it was easy to see how its constituents were united and cemented by the sarcodesma. In this new condition a mass of sarcode was nearly always accumulated, forming, in all probability, a sort of reserve destined to become converted into

tubes, grafted upon those already in existence. This new mode of living sheltered, differing essentially from the former, gave origin to a new genus, *Amphiexis*, of the family Pseudarkysiæ.

In a recent dredging at some distance from the southern shore of the Bay of Biscay, upon a bottom of coarse sand, we found some specimens of *Amphiexis*, that is to say organisms like those captured by the 'Talisman,' but differing from them in their envelope. The envelope, instead of consisting of *Globigerinæ*, is formed by an assemblage of sand-grains, of small shells of mollusca or their débris, and a little mud. They also differ in having the sarcode which envelopes the branched system much more condensed than in the specimens from our shores.

The most interesting discovery that we have made is that of a third state of the Pseudarkysiæ. It is in the form of little pebbles, and with the same hardness, that this organism presents itself. The resemblance is so perfect that one is easily deceived. The organism impregnates itself with a paste which it forms with foreign corpuscles and sarcodesma, and thus forms a sort of cake, which it "ices," so to speak, by covering it with a composition of secretion and sarcode, exactly analogous to that which forms the tests of the porcellaneous Foraminifera. The covering is just as smooth, polished, brilliant, and hard as the latter; but, instead of being white, it is coloured in several shades. The sarcode which envelopes the branched system is strongly condensed. If we break one of these little false-pebbles the fracture is of the kind known as *greasy*. This new state therefore gives occasion to the establishment of the genus *Lithozoa*, and we believe that it may be divided into several species.—*Comptes Rendus*, July 27, 1885, p. 327.

Description of a new Crustacean allied to Homarus *and* Nephrops. By Sidney I. Smith.

Any additions to the small number of known types of existing Homaridæ are of special interest on account of the relations of the group to the Astacidæ and to several fossil forms; and for this reason it seems desirable to give a special notice of the following species recently taken in the Caribbean Sea by the Fish-Commission steamer 'Albatross.'

Eunephrops, gen. nov.

The species for which this generic name is proposed agrees with *Homarus* and differs from *Nephrops* and *Nephropsis* in the number and arrangement of the branchiæ, and in the evenly swollen branchial regions; it agrees with *Nephrops* and *Homarus* and differs from *Nephropsis* in possessing antennal scales and well-developed eyes; it agrees with *Nephropsis* and differs from *Homarus* and *Nephrops* in having very large antennal spines, and in being without any spine on the second segment of the peduncle of the antennæ; and

it agrees with *Nephrops* and differs from *Homarus* and *Nephropsis* in having slender and carinated chelæ.

Eunephrops Bairdii, sp. nov.

Female.—The carapax is nearly as broad as high, and the branchial regions and the dorsum, except in front, are evenly convex and rounded. The cervical suture is conspicuous and very deep, extends round beneath the narrow lateral lobe of the gastric region, and joins the middle of a conspicuous regularly semicircular suture, limiting the hepatic region below and behind. The inferior edge of the rostrum is sharp and slightly roughened, but not distinctly dentate. From the sides of the rostrum two low rounded carinæ extend back a little way upon the gastric region, and are armed each with two spines somewhat smaller than the lateral spines of the rostrum, while much further back, upon the posterior margin of the cervical suture, there is a pair of similar subdorsal spines much nearer together. The anterior margin projects on either side in a great vertically compressed dentiform spine, reaching in an acute point as far forward as the eyes, and recalling similar spines in some of the Crangonidæ. Just behind the base of the antennal spine there is a small spine on the hepatic region, and between this and the posterior subdorsal spine of the gastric region, and behind the orbit, there is a similar spine. The carapax is everywhere roughened with minute tubercles, between which the surface is beset with very short hairs.

The eyes, though not quite so large, are nearly like those of *Nephrops norvegicus*, being vertically compressed, reniform, and black.

The antennulæ are like those of *Nephrops norvegicus*. The general form and proportions of the bodies of the segments of the peduncle of the antennæ are almost exactly as in *Nephrops norvegicus*, but the second segment is evenly convex externally and without any trace of a tooth or spine at the base of the very small antennal scale, which is very little more than half as long as the fourth segment, about half as wide as long, oblong-ovate, with a minute tooth at the tip, and with the inner edge ciliated. The flagellum is considerably longer than the body of the animal, and very nearly as in *Nephrops norvegicus*.

The oral appendages agree very closely in every detail with those of *Nephrops norvegicus*, except that there is a well-developed podobranchia, fully as large as in *Homarus americanus*, at the base of the first gnathopod.

In the single specimen seen the right cheliped is in process of reproduction and very rudimentary. The left cheliped agrees in general form very closely with the more slender of the chelipeds of *Nephrops norvegicus*; the inferior and superior edges of the merus, though roughened with somewhat spiniform granules, bear only one real spine each, and that at the distal end; the spines of the carpus are slightly fewer, but arranged nearly as in *Nephrops norvegicus*;

the chela itself is very slightly broader than in *Nephrops norvegicus*, the spines of the carinæ are a little less prominent, though the carinæ are spinulose or minutely tuberculose nearly to the tips of the digits, and the spaces between the carinæ are thickly tuberculose, and not pubescent. The remaining peræopods are very nearly as in *Nephrops norvegicus*.

The pleon is in general very much like that of *Nephrops norvegicus*, but the whole dorsum is pubescent, and the second, third, and fourth somites have only an inconspicuous, transverse, dorsally interrupted, and densely pubescent sulcus in place of the much broader and conspicuous sulci upon all the somites of *Nephrops norvegicus*. The depressions on the bases of the pleura are deeper than in *Nephrops norvegicus*, and the inferior angles are more obtuse, and not distinctly hooked, as in that species. The second to the fifth pleopods are smaller and their lamellæ much narrower than in the *Homarus americanus* or the male of *Nephrops norvegicus*.

[I have had no female *Nephrops* for comparison.]

Measurements in millimetres.

Length from tip of rostrum to tip of telson	142·0
Length of carapax, including rostrum	69·5
Length of rostrum	24·3
Length of rostrum in front of spines	13·0
Breadth between tips of antennal spines	21·5
Greatest breadth, at branchial regions	25·0
Height of carapax........................	26·0
Length of eye-stalk and eye	6·0
Greatest diameter of eye	7·0
Length of antennal scale..................	4·1
Breadth of antennal scale	2·0
Length of left cheliped	112·0
Length of merus	32·0
Length of carpus	22·0
Length of chela	54·0
Breadth of chela	12·5
Length of dactylus	24·0
Length of second peræopod	69·0
Length of merus	23·0
Length of carpus	10·5
Length of chela..........................	18·5
Breadth of chela	3·0
Length of dactylus	6·0
Length of third peræopod	65·0
Length of merus	19·5
Length of carpus	9·6
Length of chela	20·5
Breadth of chela	2·8
Length of dactylus	6·0
Length of fourth peræopod..................	67·0
Length of propodus	15·6
Length of dactylus	8·7
Length of fifth peræopod..................	58·0
Length of propodus	15·0

Length of dactylus	7·0
Length of sixth somite of pleon	13·0
Length of telson	16·0
Breadth of telson	13·3
Length of inner lamella of uropod	14·0
Breadth of inner lamella of uropod	13·3
Length of outer lamella of uropod	19·0
Breadth of outer lamella of uropod	14·0

Station 2143, March 23, 1884; Gulf of Darien; north latitude 9° 30′ 45″, west longitude 76° 25′ 30″; 155 fathoms, green mud. One female (6939).—*Proc. United States Nat. Mus.* 1885, p. 167.

New Haven, Conn., April 29, 1885.

On a Crocodile-skull from the Tertiary Deposits of Eggenburg in Lower Austria. By Franz Toula and Johann A. Kail.

The skull described by the authors was obtained from a sandy deposit containing granite-blocks and rolled pebbles on the western slope of the Calvarienberg near Eggenburg. Remains of *Halitherium* were obtained from the same locality. The crocodile-skull was in fragments, which, however, have been fitted together, and show it to have been at least 73 centim. (about 30 inches) in length from the imperfect muzzle to the hinder margin of the parietals, while the greatest width is 35·5 centim. The bones of the roof of the skull are pretty well preserved; those of the under surface only in the fore part.

From a comparison of the specimen with various recent and fossil forms the authors conclude that it represents a new form intermediate between *Gavialis* and *Crocodilus.* As regards the total number of teeth (twenty) it would agree with the genus *Tomistoma*, S. Müll. (=*Rhynchosuchus*, Huxl.), but it differs from this in having five teeth in the intermaxillaries (arranged as in *Gavialis*), and in having the sixth upper tooth the largest, instead of the fifth as in *Tomistoma.* The teeth of the lower jaw fit into pits between those of the upper jaw, the extremity of the snout is not enlarged, and the suture of the intermaxillaries extends only to the third tooth of the supramaxillaries— characters indicating relationship with *Tomistoma*, while the raised orbital margins remind one of *Gavialis. Mecistops* has only seventeen teeth, and is further distinguished by the enlargement of the snout at the end and in the region of the fifth upper tooth; while *Gavialis* has from twenty-seven to twenty-eight teeth directed outwards, and differs in other characters. The authors conclude that their specimen is to be regarded as a form intermediate between *Gavialis* and *Crocodilus*—most nearly related to the genus *Tomistoma*, which is now living in the rivers of Borneo and North Australia—which they propose to name *Crocodilus* (*Gavialosuchus*, n. gen.?) *eggenburgensis.—Anzeiger d. k. Akad. d. Wiss. in Wien*, May 7, 1885, p. 107.

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PROCEEDINGS OF LEARNED SOCIETIES.

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*** It is requested that all Communications for this Work may be addressed, post-paid, to the Care of Messrs. Taylor and Francis, Printing Office, Red Lion Court, Fleet Street, London.

Vol. 16. FIFTH SERIES. No. 94.

THE ANNALS
AND
MAGAZINE OF NATURAL HISTORY,
INCLUDING
ZOOLOGY, BOTANY, AND GEOLOGY.

No. XCIV.

OCT. 1885.

CONDUCTED BY
ALBERT C. L. G. GÜNTHER, M.A., M.D., PH.D., F.R.S.,
WILLIAM S. DALLAS, F.L.S.,
WILLIAM CARRUTHERS, F.R.S., F.L.S., F.G.S.,
AND
WILLIAM FRANCIS, PH.D., F.L.S.

BEING A CONTINUATION OF THE "ANNALS" COMBINED WITH MESSRS. LOUDON AND CHARLESWORTH'S "MAGAZINE OF NATURAL HISTORY."

WITH THREE PLATES.

Illustrative of Mr. R. Kidston's Paper on the Relationship of *Ulodendron* to *Lepidodendron*, &c.; Mr. A. G. Butler's on Lepidoptera from Manipur and the Borders of Assam; the Rev. O. P. Cambridge's on two new Species of Araneidea; and Miss S. G. Foulke's on *Chilomonas paramæcium.*

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

No. 94. OCTOBER 1885.

XXIII.—*Descriptions of two new Species of Araneidea.* By the Rev. O. P. Cambridge, M.A. &c.

[Plate IX. A. figs. 1 & 2.]

Family **Dictynidæ**.

Genus Dictyna, Sund.

Dictyna cognata, sp. nov. (Pl. IX. A. fig. 1, *a*, *b*, *c*, *d*.)

Adult male, length $1\frac{1}{3}$ line.

In general appearance and size this spider nearly resembles *Dictyna arundinacea*, Linn., to which it is closely allied. It may, however, be easily distinguished by the spur on the radial joint of the palpus. This spur is longer than in *D. arundinacea*, its length being nearly equal to the breadth of the base of the radial joint; it is also stouter, bent, placed close to the base of that joint, and bifid at its extremity. The radial is a little longer than the cubital joint, and its spur is shorter than that of *D. uncinata*, Thor., from which it also differs in the abdominal pattern. This pattern nearly resembles that of *D. arundinacea*.

The spider from which the above notes have been made was received from Holland, where it was found by Major-General A. W. M. van Hasselt, who kindly submitted it to my inspection, and has permitted me to describe it.

Family **Theridiidæ**.

Genus Lithyphantes.

Lithyphantes morsitans, sp. nov.
(Pl. IX. A. fig. 2, *a*, *b*, *c*.)

Adult female, length $2\frac{2}{3}$ lines.

Cephalothorax short, broad behind, constricted laterally at

the caput; its colour is yellow-brown with a broad lateral margin and the upper part of the caput of a deep brown. The latter forms a longitudinal wedge-shaped band including the eyes and continued backwards to the thoracic junction.

The *eyes* are pearly white, the four centrals form nearly a square; those of each lateral pair are contiguous to each other, and seated slightly obliquely on a small tubercle. The height of the clypeus exceeds slightly half that of the facial space.

The *legs* are slender, not very long, and furnished with hairs and slender bristles. They are of a dark yellow-brown hue; the femora have a single pale yellow-brown annulus near their anterior extremity, and the tibiæ two pale annuli; the metatarsi and tarsi are paler than the other joints. The relative length of the legs is 1, 2, 4, 3.

Palpi short, slender, and of a dark yellow-brown colour, furnished with hairs and a few bristles.

Falces not very long, rather weak, similar in colour to the cephalothorax.

Maxillæ, *labium*, and *sternum* normal, and of a deep brown colour.

The *abdomen* is very large and globular, and projects considerably over the base of the cephalothorax. Its surface is glossy, of a black colour, sparingly furnished with hairs, and with a rather sharply dentated, longitudinal, median band on the upper side, continued in the form of a narrow simple band backwards to the spinners. This band is of a dull pale hue, tolerably distinctly edged with white; some two or three more or less distinct oblique stripes of a similar nature occupy the sides; and on the underside, between the spinners and the genital aperture, is a white spot or marking.

An example of this spider, alive, was kindly given to me by the Rev. G. Aldridge, vicar of Morden, Dorset. It had come to him by post in a small match-box from a friend in Swaziland, Africa, where it is (probably not without reason) considered venomous. I endeavoured to keep it alive, but it refused to eat, and soon died.

EXPLANATION OF PLATE IX. A. figs. 1, 2.

Fig. 1. *Dictyna cognata*, sp. n. *a*, abdomen, upperside, ♂; *b*, genital aperture, ♀; *c*, palpus, ♂; *d*, portion of palpus, ♂, in another position.

Fig. 2. *Lithyphantes morsitans*, sp. n. *a*, full figure, ♀; *b*, outline ditto, in profile; *c*, natural length of spider.

XXIV.—*On the Relationship of* Ulodendron, *Lindley and Hutton, to* Lepidodendron, *Sternberg*; Bothrodendron, *Lindley and Hutton*; Sigillaria, *Brongniart*; *and* Rhytidodendron, *Boulay*. By Robert Kidston, F.G.S.

[Plates III.–VII.]

[Concluded from page 179.]

It is necessary before leaving this portion of our subject to make a few remarks on the Ulodendroid scars. It has been stated by some authors that the large concave Ulodendroid scars bore traces of leaf-scales; by others that these were never present. It is, however, now unquestionable that at one period of their development the whole area which now forms the Ulodendroid scar was covered with leaf-scales. This is clearly shown in Pl. IV. fig. 2 (specimen No. 3), and in another and slightly older example (specimen No. 7). It has also been stated, by those who believe that the surface of the Ulodendroid scars originally bore leaf-scales, that these were arranged in a system peculiar to the area of the scar. At all events in the two examples just mentioned the leaf-scars on the surface of the Ulodendroid scars are continuations of the ordinary leaf-spirals of the stem. The presence, then, of the leaf-scars on the Ulodendroid scar conclusively proves that the appendicular organ, whatever its nature may have been, cannot have been attached to the whole surface of the scar, but only to its umbilicus. Further conclusive proof of this is afforded by the Blackbraes specimen (No. 6) of *Lepidodendron Veltheimianum*. (Pl. VI. fig. 11.)

The formation of the Ulodendroid scar may be thus briefly described. In its earliest condition that has come under my notice the area that supports the appendicular organ is slightly elevated (Pl. IV. fig. 2). The specimen (No. 7) which shows the succeeding stage of development exhibits a clearly defined semilunar outline, limiting the upper part of the scar, but no boundary-line towards its lower part is yet visible. At this stage of progression the leaf-scars are clearly seen on the surface of the Ulodendroid scar, from the umbilicus downwards.

Fig. 9, Pl. V. (*Sigillaria Taylori*), shows the attached appendicular organs in a young state of growth. They are directed upwards, and consequently the pressure exerted on the bark by their leaves or bracts will be much greater on the upper part of the Ulodendroid scar from the acute angle the attached organ forms with the stem; and, in fact, it is on the

upper part of the Ulodendroid scar that the leaf-scars are first effaced. The continued pressure of the appendicular organ against the cortex, augmented by the increase in girth of the stem, causes the bark to swell up around its base, and thus the characteristic Ulodendroid depressions are formed. On the upper part of the Ulodendroid scar the leaves of the attached organ first obliterate all traces of the leaf-scars, and finally impress their own strap-shaped outline as radiating lines from the umbilicus. On the lower part of the scar circumstances modify the case. The space here between the attached organ and the bark is much greater than in the upper portion of the scar; hence, though the attached organ effaces the leaf-scars on the stem by its leaves or bracts pressing on its surface, they have not sufficient power to impress their outline on the Ulodendroid scar; thus the little "dots," which mark the channels through which the foliar bundles have passed are left to indicate the position of the stem-leaves. As Schimper has pointed out, there cannot remain much doubt that the appendicular organs result from a series of unequal dichotomies, which were alternately fertile and barren, the fertile probably forming deciduous cones, the barren carrying on the axis of the plant.

Of actual cases where the appendicular organ has been found *in situ* I only know of five:—first, that mentioned by Dr. Hooker*; the second the notice given by Dr. Dawson, who mentions having seen on one occasion the cones attached to the stem †; the third the specimen figured by Mr. D'Arcy Thompson ‡; the fourth and fifth those shown in figures 9 and 11 of this communication. That the appendicular organs were aerial roots, as supposed by Mr. Carruthers §, has been pointed out by Dr. Williamson || and fully corroborated by the specimens described in this paper.

* Mem. of the Geol. Survey of Great Britain, vol. ii. part 2, p. 427.

† Acadian Geol. 2nd ed. p. 456 (1868).

‡ Trans. Edinb. Geol. Soc. vol. iii. pl. (B).

§ Note.—The specimen on which Mr. Carruthers founded his belief that the attached organs were aerial rootlets and directed downwards, and which he figures on pl. xliii. fig. 5 of the Monthly Micr. Journ. for March 1870, is in the collection of the British Museum (Natural History). This specimen does not belong to *Ulodendron*, L. & H., but is a Halonian branch of *Lepidophloios*. On the opposite side of the specimen to that figured there is a third row of tubercles; hence it cannot be a *Ulodendron*, L. & H. Again, the leaf-scars in *Lepidophloios* are directed downwards, and the view of those he gives in fig. 6 of the same plate proves most conclusively that he has been dealing with *Lepidophloios*, and not *Ulodendron*. His fig. 5, then, is inverted; so if his specimen were placed in its true position, the tubercles would be directed upwards, which conforms with the ordinary Halonian branches of *Lepidophloios*.

|| Phil. Trans. vol. clxxii. p. 209 (1872).

That the appendicular organs were caducous cones seems most probable; but I have not seen evidence sufficiently clear to decide positively whether they were sessile or stalked. From the evidence before us, however, and taking into account the morphological significance of the attached organ, I have a strong bias in favour of the opinion that the appendicular organs were sessile cones. The view advocated by Stur that they were bulbils does not appear to me to be at all probable, and against it Schimper has stated sufficient objections*.

Before meeting with the specimens which form the subjects of figures 2 and 9, it had often been a mystery to me why we never found Ulodendroid scars on small stems, especially as Halonian branches of *Lepidophloios scoticus*, Kidston, about half an inch in diameter, are frequent. This difficulty is quite cleared up by an examination of the specimens nos. 3 and 18, of which the portion drawn in Pl. IV. fig. 2, is from a stem $4\frac{1}{2}$ inches broad (specimen No. 3), and that in Pl. V. fig. 9 (specimen No. 18) from another over 3 inches wide. It appears, then, that in the so-called *Ulodendra* it was only the older stems that bore lateral cones.

It has already been pointed out that plants belonging to the genus *Rhytidodendron*, Boulay, also possessed two opposite rows of Ulodendroid scars †. It is true that Ulodendroid specimens comparatively seldom show the leaf-scars well preserved, and that on some of the described species of *Ulodendron* they have not been observed; still that does not alter the fact that when well-preserved examples are examined they show leaf-scars which conform to one or other of the three genera *Lepidodendron*, *Sigillaria*, or *Rhytidodendron*, as already mentioned. But if the form of the leaf-scar is of generic value in *Lepidodendron*, *Sigillaria*, and *Rhytidodendron*, on what grounds can we ignore the value of the same character in *Ulodendron*? If, then, those plants with Ulodendroid scars are to be excluded from *Lepidodendron*, *Sigillaria*, and *Rhytidodendron*, it will be necessary to form three new genera for these plants—one for the Lepidodendroid *Ulodendra*, another for the Sigillarian *Ulodendra*, and a third for the Rhytidodendroid *Ulodendra*. This view, however, I am not prepared to adopt, as I think the plants find a suitable and natural place in the genera *Lepidodendron*, *Sigillaria*, and *Rhytidodendron* respectively.

Branching of Ulodendroid Stems.

The Sigillarian as well as the Lepidodendroid species of

* See *ante*, p. 135. † See *ante*, p. 138.

the so-called genus *Ulodendron* dichotomized in a similar manner to that which occurs in *Sigillaria* and *Lepidodendron.* In the former genus the dichotomizing of the stem appears to have been much more feebly developed than in *Lepidodendron*, and, in fact, there is strong evidence to show that some *Sigillariæ* did not dichotomize at all *; but in regard to other *Sigillariæ* it is equally clear that they possessed a dichotomized ramification †. Of *Sigillaria Taylori*, Carr. sp., several dichotomizing examples have been found and described ‡.

The termination of these Ulodendroid stems has, however, only been twice observed—first by Hugh Miller §, who described it as having an "abrupt cactus-like termination," and the other case is that figured in Pl. VI. fig. 10 (specimen No. 17). This example is referable to *Sigillaria Taylori*, to which species Hugh Miller's fossil most probably belonged. I am not aware that any termination of a Ulodendroid branch of *Lepidodendron Veltheimianum* has ever been discovered. That they dichotomized in the ordinary manner has been pointed out by Tate ‖. Mr. Carruthers also gives a woodcut of a specimen in a similar condition ¶. I agree with Stur in believing that *Lepidodendron Veltheimianum*, in addition to bearing lateral cones (according to Stur lateral bulbils), also bore terminal cones. Mr. C. W. Peach has shown me a large slab, which I believe to be referable to *Lepidodendron Veltheimianum*, on which are exhibited twenty-two cones attached to small terminal twigs **.

Although our knowledge of the so-called *Ulodendra* has been considerably augmented within the last few years, and to such an extent that it appears to me impossible to regard *Ulodendron*, Lindley and Hutton, as forming a true genus, still there remain many points in regard to the structure of these plants of which we at present possess only very imperfect information, and it is only by patient continued observation and collecting that we may ever hope to clear up those points which are still involved in obscurity. I for one feel very hopeful that many difficulties, not only in regard to the Ulodendroid Lycopods, but in many other branches of fossil botany, will yet be satisfactorily cleared up, only we must

* Goldenberg, 'Flora Saræpontana fossilis,' Heft i. p. 25, pl. B. fig. 13 (*Sig. reniformis*).

† Stur, Culm Flora, p. 296 (402), pl. xxv. (xlii.) (*Sigillaria Eugenii*).

‡ Thompson, *l. c.* p. 349; H. Miller, 'Testimony of the Rocks,' p. 464.

§ *L. c.* p. 464.

‖ Tate, in Johnston's Nat. Hist. of the Eastern Borders, p. 302 (1853).

¶ Monthly Micr. Journ. vol. iii. p. 148 (1870).

** Collected at Grange Quarry, Burntisland, Fife, in Aug. 1876 (Calciferous-Sandstone series).

wait till specimens are discovered which may fill in the missing links, and not in the meantime supply what is at present desiderated from the fertile regions of imagination and desire.

IV. Synonymy and Notes on the three Species specially considered in this Communication.

Lycopodiaceæ.

Lepidodendron, Sternberg, 1820.

[Versuch eines geognostisch-botanischen Darstellung der Flora der Vorwelt, I. fasc. i. p. 25, fasc. iv. p. x.]

Lepidodendron Veltheimianum, Sternberg. (Pl. III. fig. 1, Pl. IV. figs. 2, 3, 4, Pl. VI. fig. 11.)

Lepidodendron Veltheimianum, Bronn, Index Palæont. p. 631; Dawson, Foss. Plants of Lower Carb. and Millstone Grit, p. 8; Etheridge, Catalogue of Australian Fossils, p. 31; Grand'Eury, Flore carbon. du Dép. de la Loire, p. 138; Heer, Urwelt d. Schweiz, p. 7, fig. 2; id. Foss. Flora d. Bären Insel, p. 38, pl. viii. figs. 1, 2 *a–b*, 3, 4, 5 *a*, 6, 7, pl. ix. figs. 3, 4 (? fig. 2 *a*); id. Steink.-Flora d. arktischen Zone, p. 4, pl. iv. and pl. v. fig. 3; id. Flora foss. Helv. Lief. i. p. 37, pl. xviii. fig. 6 (?); Kidston, in Cadell, Trans. Ed. Geol. Soc. vol. iv. p. 335; König, Icones fossilium sectiles, pl. xviii. fig. 236; Lesquereux, Coal Flora of Pennsylv. p. 374, pl. lxii. figs. 6–8; id. Geol. Surv. of Illin. vol. ii. p. 455; Renault, Cours d. botan. foss. p. 9, pl. v. figs. 1–2 (1882); Schimper, Traité d. paléont. végét. vol. ii. p. 29; Schmalhausen, Mélanges Phys. et Chim. vol. x. p. 745, pl. i. figs. 4–7; Sternberg, Vers. i. fasc. 4, p. xii, pl. lii. fig. 3; Sterzel, Bericht d. naturwis. Gesellsch. zu Chemnitz, vol. ix. p. 215 (1884); Stur, Culm Flora, Heft i. p. 79, Heft ii. p. 375, pl. xviii. figs. 2–3, pl. xix. figs. 5, 6 (8 ?), 9, 10, pl. xx. figs. 1–6, pl. xxi., pl. xxii. fig. 3 (excl. figs. 1, 2); Unger, Genera et Species, p. 256; Zeiller, Végét. foss. du terr. houil. p. 110, pl. clxxii. figs. 3, 4.

Sagenaria Veltheimiana, Dawson, Quart. Journ. Geol. Soc. vol. xviii. p. 299; Ebray, Végét. foss. d. terr. d. transition, p. 19, pl. v. (in part), pls. vi., vii., and viii.; Eichwald, Lethæa Rossica, vol. i. p. 119, pl. vii. figs. 2–6; Ettingshausen, Foss. Flora d. Mähr-schles. Dachschiefers, p. 106; Feistmantel, Zeitschr. d. deutsch. geol. Gesellsch. vol. xxv. p. 528, pl. xvii. figs. 31, 32; Geinitz, Flora Hain.-Ebersd. p. 51, pls. iv., v., vi. figs. 1–3; Giebel, Deutschl. Petrefacten, p. 80; Göppert, Foss. Flora d. Uebergangsgebirges, p. 180, pls. xvii.–xx., xxiii. figs. 1–3, xxiv., and xliii. fig. 1; id. Neues Jahrb. p. 684 (1847); id. Flora d. Silur., Devon., u. unter. Kohl. p. 520, pls. xl. figs. 3–4, xli. figs. 2, 4, xlii. fig. 1, and xliii.; id. Zeitschr. d. d. geol. Gesellsch. vol. iii. p. 195; Römer, Palæontographica, vol. iii. p. 46, pl. vii. fig. 14 (1854); id. ibid. vol. v. p. 40, pl. viii. figs. 1–2 (figs. 4 & 5 ?) (1855); id. ibid. vol. ix. p. 10, pl. iii. fig. 6 (1862); id. Geol. v. Oberschlesien, p. 55; Schimper, Végét. foss. du terr. de trans. d. Vosges, p. 336, pls. xx., xxi., xxii., and xxvi. fig. 6; Sternberg, Vers. ii. p. 180, pl. lxviii. fig. 14.

Stigmaria (?) *Veltheimiana*, Brongniart, Prodrome, p. 88; Unger, Syn. plant. foss. p. 117.

Lepidodendron acuminatum, Stur, Culm Flora, Heft ii. p. 397, pl. xxxix. fig. 4; Unger, Genera et Species, p. 261.

Sagenaria acuminata, Feistmantel, Zeitschr. d. d. geol. Gesellsch. vol. xxv. p. 533; Göppert, Flora d. Silur., Devon., u. unt. Kohlenf., p. 524; id. Zeitschr. d. d. geol. Gesellsch. vol. iii. p. 196; id. Foss. Flora d. Uebergangsgebirges, p. 185, pls. xxiii. fig. 4, xliii. figs. 8–10; id. Neues Jahrb. p. 684 (1847); Ludwig, Palæontographica, vol. xvii. p. 123, pl. xxvi. fig. 2; Römer, Geol. v. Oberschlesien, p. 55; Schimper, Végét. du terr. trans. d. Vosges, p. 338, pl. xxvi. figs. 1–5.

Lepidodendron geniculatum, Schimper, Traité d. paléont. végét. vol. ii. p. 33.

Sagenaria geniculata, Giebel, Deutschl. Petrefacten, p. 80; Göppert, Foss. Flora d. Uebergangsgebirges, p. 186; Römer, Palæontographica, vol. iii. p. 46, pl. vii. fig. 13 (1854).

Lepidodendron patens, Schimper, Traité d. paléont. végét. vol. ii. p. 36.

Selaginites patens, Brongniart, Prodrome, p. 84; id. Hist. d. végét. foss. vol. ii. pl. xxvi.; Bronn, Index palæont. p. 1132; Unger, Syn. plant. foss. p. 141; id. Genera et Species, p. 272.

Lepidodendron glincanum, Schimper, Traité d. paléont. végét. vol. ii. p. 34; Schmalhausen, Mém. Acad. Impér. d. Sc. d. St. Pétersbourg, 7e sér. vol. xxxi. p. 11, pl. ii. figs. 1 and 5–15, pl. iii. figs. 1–14 (1883) (excl. other figs. and syn. *L. Volkmannianum*).

Sagenaria glincana, Eichwald, Lethæa Rossica, vol. i. p. 127, pl. v. figs. 21 & 22, pl. v. *a*, figs. 1–6 (? figs. 7–10).

Sagenaria confluens, Eichwald, Lethæa Rossica, vol. i. p. 121, pl. vii. fig. 1 (excl. syns.).

Lepidodendron gracile, Römer, Palæontographica, vol. xiii. p. 213, pl. xxxv. fig. 7.

Lepidodendron Jaschei, Römer, Palæontographica, vol. xiii. p. 213, pl. xxxv. fig. 6; Schimper, Traité d. paléont. végét. vol. ii. p. 32.

Sagenaria polyphylla, Geinitz, Flora Hainichen-Ebersd. p. 53, pl. vii.

Sagenaria aculeata, Feistmantel, Zeitschr. d. d. geol. Gesellsch. vol. xxv. p. 531, pl. xvii. fig. 33; Göppert, Flora d. Silur., Devon., u. unt. Kohl. p. 519, pls. xxxix., xl., xli.

Lepidodendron Sternbergii, Heer, Foss. Flora Spitzbergens, p. 11, pls. iii. figs. 1–20, iv. figs. 3 & 4 (excl. refs.).

Lepidodendron selaginoides, Heer, Foss. Flora Spitzbergens, p. 14, pl. iii. fig. 21.

Sagenaria caudata, Geinitz, Flora Hainichen-Ebersd. p. 53, pl. iv. fig. 4; Römer, Palæontographica, vol. ix. p. 9, pl. iii. fig. 5.

Sagenaria elliptica, Göppert, Foss. Flora d. Uebergangsgebirges, p. 184, pl. xliii. fig. 7; Ludwig, Palæontographica, vol. xvii. p. 122, pl. xxvi. fig. 1, *a*, *b*, *c*, *d*.

Lycopodites dilatatus, Geinitz, Flora Hainichen-Ebersdo. p. 46, pl. x. fig. 1.

Lepidodendron ornatissimum, Brongniart, Prodrome, p. 85; id. Hist. d. végét. foss. vol. ii. pl. xviii.; Sternberg, Vers. i. fasc. 4, p. xii.

Lepidodendron commutatum, Heer, Foss. Flora d. Bären Insel, p. 39, pl. vii. figs. 8–10.

Bergeria regularis, Schmalhausen, Bull. de l'Acad. Impér. d. Sc. d. St. Pétersbourg, vol. xxii. p. 281, pl. ii. figs. 4 & 5.

Bergeria alternans, Schmalhausen, Bull. de l'Acad. Impér. d. Sc. d. St. Pétersbourg, vol. xxii. p. 281, pl. ii. fig. 6.

Knorria acicularis, Göppert, Foss. Flora d. Uebergangsgebirges, p. 200,

pl. xxx. fig. 3; Heer, Foss. Flora d. Bären Insel. p. 42, pl. viii. fig. 2 *d*, pl. x. figs. 6 & 7.

? *Knorria anceps*, Eichwald, Lethæa Rossica, vol. i. p. 153, pl. xii. figs. 2 & 3.

? *Knorria mammillaris*, Eichwald, Lethæa Rossica, vol. i. p. 155, pl. ix. fig. 4.

Knorria imbricata, Geinitz, Flora Hain.-Ebersd. p. 57, pls. viii. fig. 3, ix. figs. 1–3 (excl. figs. 2 and 4).

Flemingites pedroanus, Carruthers, Geol. Mag. vol. vi. p. 151, pl. v. (1869).

? *Ptychopteris macrodiscus*, Eichwald, Lethæa Rossica, vol. i. p. 106, pl. v. figs. 2 & 3.

Ulodendron commutatum, Lesquereux, Coal-Flora of Pennsylv. p. 401, pl. lxvi. fig. 2; Schmalhausen, Mém. de l'Acad. Impér. d. Sc. d. St. Pétersbourg, 7e sér. vol. xxxi. p. 17, pl. iv. figs. 7 & 8; Schimper, Traité d. paléont. végét. vol. ii. p. 40, pl. lxiii.

Ulodendron parmatus, Carruthers, Monthly Microsc. Journ. vol. iii. p. 152, pl. xliv. fig. 1.

Ulodendron Allani, Bronn, Index palæont. p. 1341; Buckland, Geol. and Mineral. vol. ii. p. 92, pl. lvi. fig. 6.

Ulodendron ovale, Carruthers, Monthly Microsc. Journ. vol. iii. p. 152, pl. xliv. fig. 1.

Ulodendron pumilum, Eichwald, Lethæa Rossica, vol. i. p. 144, pl. x. fig. 5.

Ulodendron Rhodeanum, Bronn, Index palæont. p. 1341; Unger, Syn. plant. foss. p. 135.

Ulodendron Rhodii, Buckland, Geol. and Mineral. vol. ii. p. 93, pl. lvi. fig. 6.

Ulodendron ellipticum, ? Bronn, Index palæont. p. 1341; Eichwald, Lethæa Rossica, vol. i. p. 140, pls. ix. figs. 6 & 7, x. figs. 3, 4, & 6; ? Goldenberg, Flora Saræpontana fossilis, Heft i. p. 18; ? Sternberg, Vers. ii. p. 186, pl. xlv. fig. 2; ? Unger, Syn. plant. foss. p. 135; ? id. (in part) Genera et Species, p. 264.

Ulodendron minus, Thompson (in part), "Notes on *Ulodendron*," Trans. Geol. Soc. Edinb. vol. iii. p. 341, pl. *a*. figs. 2–3.

Ulodendron transversum, Eichwald, Lethæa Rossica, vol. i. p. 139 (? pl. vi. fig. 13), pl. ix. fig. 8.

Ulodendron ornatissimum, Tate, in Johnston's Nat. Hist. of the Eastern Borders, vol. i. p. 302 (1853).

Phytolithus parmatus, Steinhauer (in part), Amer. Phil. Trans. vol. i. 2nd ser. p. 287, pl. vii. fig. 1 (1818).

Vegetable Impression, Allan, Trans. Roy. Soc. Edinb. vol. ix. p. 235, pl. xiv. (1823).

"*Schuppenpflanzen*," Rhode, Beitr. z. Pflanzenk. d. Vorwelt, p. 16, pl. iii. figs. 1–8.

Remarks. Lepidodendron acuminatum appears to be only a varietal form of *Lepidodendron Veltheimianum*, with which it has already been united by Schimper.

Lepidodendron geniculatum is also merely a form of the same species.

Lepidodendron patens (*Selaginites patens*, Brongn.), from the neighbourhood of Edinburgh, is likewise to be referred to *Lepidodendron Veltheimianum*. The peculiarities of Brongniart's specimen arise from its mode of preservation,

and many specimens from the Calciferous-Sandstone series, from which horizon Brongniart's example evidently originated, show the same characters. The peculiar appearance of the fossil to which the name of *Selaginites patens* has been given is caused by the basal portions of the leaves still retaining their attachment to the stem; and in other cases I have observed a very similar appearance produced by the leaves being adpressed (probably through mechanical agency) to the branches. Although not for a moment doubting that the specimens to which I refer are similar to that figured in vol. ii. pl. xxvi. of the Hist. d. végét. foss., examples with such an extremely scaly appearance are rare; but I have two at least in which it is as well marked as in the type figure of *Lepidodendron patens*, Brongn. sp.

Schmalhausen has united *Lepidodendron glincanum*, Eichwald, and *Lepidodendron Volkmannianum*, Sternberg, with *Lepidodendron Veltheimianum*, Sternberg *.

With regard to *Lepidodendron glincanum*, I cannot find any point by which it can be separated from *Lepidodendron Veltheimianum*, and therefore include it under that name. *Lepidodendron Volkmannianum* seems an altogether distinct species, and cannot be united with *Lepidodendron Veltheimianum.*

Lepidodendron (*Sagenaria*) *glincanum*, Eichwald, Lethæa Rossica, pl. v. *a*, fig. 7, should perhaps be referred to *Lepidodendron Volkmannianum.*

Lepidodendron (*Sagenaria*) *aculeatum*, Feistmantel and Göppert, *Lepidodendron Sternbergii* and *Lepidodendron selaginoides*, Heer, and *Lepidodendron* (*Sagenaria*) *caudatum*, Geinitz and Römer †, are all, I believe, referable to *Lepidodendron Veltheimianum.*

Lepidodendron Jaschei and *Lepidodendron gracile*, Römer†, are both young conditions of *Lepidodendron Veltheimianum.*

The transverse bars that occur on the leaf-scars of *Lepidodendron gracile* have most probably been produced by shrinkage, and are frequently present on other species of *Lepidodendron.*

Bergeria regularis and *Bergeria alternans*, Schmalhausen†, only appear to represent different conditions of preservation of *Lepidodendron Veltheimianum.*

The core which lifted out of an impression of *Lepidodendron Veltheimianum* in my own collection agrees so entirely

* Mém. de l'Acad. d. Sc. de St. Pétersbourg, 7e sér. vol. xxxi. no. 13, p. 11.

† For figures specially referred to see synonyms given on pp. 243–245.

with *Knorria acicularis* that I have no hesitation in referring that fossil to this species.

The explanation of how *Knorria* is formed will be learnt from an examination of the internal structure of *Lepidodendron*. As far as the present example of *Knorria acicularis* is concerned, the more delicate tissue surrounding the central vascular bundle appears to have decayed, and the bundle thus freed has probably floated out of the cortical cylinder, which subsequently became filled with sediment. Pressure now acting on the cortical cylinder has forced the mud which filled its interior up the small channels through which the foliar vascular bundles passed to the leaves; the bark next appears to have decayed, leaving the impression of its outer surface on the surrounding matrix. The preservation of the casts of the vascular-bundle channels has been assisted by the decayed bark remaining around them in the form of a fine powder, and so helping to prevent their obliteration by subsequent pressure or infiltration. In this manner were formed the little acicular points (the casts of the channels through which the foliar vascular bundles passed) which characterize *Knorria acicularis*, Göppert. Some specimens of *Knorria imbricata* appear to be formed by a partial decay of the outer surface of the bark before fossilization took place.

It is impossible to correlate the various named species of *Knorria* with the plants to which they really belong, as any species of *Lepidodendron* might produce one or more species of *Knorria*, according to the conditions which attended its mineralization *. *Lepidophloios* and the Clathrarian *Sigillariæ* might also form *Knorria*-like fossils.

The type of *Flemingites pedroanus*, Carruthers, is in the collection of the British Museum. I have failed to see any character in which it differs from *Lepidodendron Veltheimianum*.

The figure given by Mr. T. Allan of a vegetable impression found in the quarry of Craigleith is a good example of *Lepidodendron Veltheimianum* showing the Ulodendroid scars †. This example was subsequently named *Ulodendron Allani* by Buckland and *Lepidodendron ornatissimum* by Brongniart. Lindley and Hutton mention Allan's figure as syno-

* There is in my collection a core, which lifts out of an impression of typical *Lepidodendron Veltheimianum*, and is identical with the figure of *Lepidodendron tetragonum* as given by Geinitz in his 'Darstellung der Flora des Hainichen-Ebersdorfer und des Flohaer Kohlenbassins,' pl. iii. fig. 2. My example came from the Calciferous-Sandstone series, Water of Leith, between Slateford and Colinton, Midlothian.

† Trans. Roy. Soc. Edinb. vol. ix. pl. xiv.

nymous with their *Ulodendron minus*; but this is a mistake, for Allan's specimen shows the Lepidodendroid leaf-scar, whereas Lindley and Hutton's plant belongs to the Sigillarian section of *Ulodendron*. The plate of *Ulodendron minus*, L. & H., would not at first lead one to this view; but from an examination of the counterpart of their fossil, all that is now preserved of their type*, I have been led to this conclusion. *Ulodendron majus*, L. & H., is only an older and larger example of their *Ulodendron minus*; hence its supposed identity with Rhode's pl. iii. fig. 1 is also erroneous. *Lepidodendron ornatissimum* and Rhode's pl. iii. figs. 1–8 are both referable to *Lepidodendron Veltheimianum*. Here must likewise be placed Eichwald's figures of *Ulodendron ellipticum*, which all appear to represent more or less imperfectly-preserved specimens of *Lepidodendron Veltheimianum*; his pl. x. fig. 6 †, in addition to exhibiting the leaf-scars of this *Lepidodendron*, shows also on other parts of the same fossil scars so preserved that they might be named with all propriety "*Knorria*." It is questionable whether most of the other figures which by different authors have been referred to *Ulodendron ellipticum* really belong to this plant.

Ulodendron transversum, Eichwald †, pl. ix. fig. 8, is another example, and a very interesting one, of the Ulodendroid condition of *Lepidodendron Veltheimianum*. In this figure are seen the characteristic leaf-scars, a *Knorria* condition, a decorticated state of the stem, and, finally, the large Ulodendroid scar. Eichwald's fig. 13, pl. vi., also probably belongs to this species, but the actual proof that it does so is not shown in the figure, which represents merely a *Knorria* condition of *Lepidodendron*.

Similar remarks to those just made on Eichwald's fig. 8, pl. ix., may also be applied to his *Ulodendron pumilum* ‡, pl. x. fig. 5. The large Ulodendroid scar appears to have been partly covered by the matrix, and consequently looks smaller than in some other examples, but does not seem to be specifically distinct from them. It is identical with his *Ulodendron transversum*, with which the leaf-scars agree in all particulars.

It is probable that the *Ptychopteris microdiscus* of the same author is only a badly-preserved specimen of *Lepidodendron Veltheimianum*. There is little evidence to support the view that this fossil is a fern-stem.

* In the "Hutton Collection," Newcastle-on-Tyne.

† For full reference see synonyms to *Lep. Veltheimianum*, p. 245.

‡ This is not the same species as that subsequently named *U. pumilum* by Mr. Carruthers.

Under *Pachyphlœus tetragonus*, Göppert * appears to have included portions of different plants. His fig. 5 cannot be distinguished from a Ulodendroid scar of *Lepidodendron Veltheimianum*, but his other figures do not seem to belong to this plant.

Some writers have proposed the union of *Lepidodendron corrugatum*, Dawson, with *Lepidodendron Veltheimianum*; and "so closely does the last species resemble *Lepidodendron corrugatum*, that Schimper and other palæobotanists conversant with the protean forms of this species, and knowing ours only by imperfect figures, may well be excused for regarding them as identical" †. As mentioned in the above quotation, some figures of *Lepidodendron corrugatum* are scarcely distinguishable from *Lepidodendron Veltheimianum*; but, through the kindness of Sir Wm. Dawson, who has forwarded me a series of specimens representing his plant at different stages of growth, I have been able to compare them with well-preserved examples of *Lepidodendron Veltheimianum*, and feel convinced that *Lepidodendron Veltheimianum*, Sternberg, and *Lepidodendron corrugatum*, Dawson, cannot be united.

The three figures given by Stur in his 'Culm Flora,' pl. xxxix. figs. 1 *a*, 1 *b*, and 2, do not belong to this species, but to *Sigillaria Taylori*, Carruthers, sp.

Localities and Horizons.

SCOTLAND—Carboniferous-Limestone Series.

Ayrshire: Spittal Hill, Craigie Range, 3¼ miles S.E. of Kilmarnock (*Rev. D. Landsborough*).

Lanarkshire: Shale above Calderwood Cement-stone, East Kilbride (*A. Patton*); Possil Ironstone, Keppock Hill, near Glasgow (*J. Bennie*); Carluke (*collection of British Museum*).

Linlithgowshire: Roof of Easter Main Coal, Bo'ness (*H. M. Cadell*); Shale above Ironstone, No. 6 Pit, Grange, Bo'ness (*H. M. Cadell*); Brown Ironstone, Bo'ness (*H. M. Cadell*); Blaes, 20 feet above Lower Ironstone, No. 6 Pit, Grange, Bo'ness (*H. M. Cadell*).

Midlothian: Cowden, near Dalkeith (*D. Grieve*); Burghlee Pitt, near Loanhead.

Stirlingshire: Todholes, Bannockburn, about 400 yards above Bridge on Denny Road; Raploch Quarry, near Stirling (*G. Macdougall*).

* Syst. fil. foss. p. 468, pl. xliii.

† Dawson, Foss. Plants of Lower Carbon. and Millstone-Grit Formations of Canada, p. 21.

SCOTLAND—Calciferous-Sandstone Series.

Berwickshire: Shore, Cove, Cockburnspath (*J. Bennie*); Cliff, Cove, Cockburnspath (*J. Bennie*).

Fife: Kilmundy Limestone Quarry, Burntisland (*J. Bennie*); Kilmundy Sandstone Quarry, Burntisland (*J. Bennie*); Grange Quarry, Burntisland; Dodhead Quarry, 1 mile N.E. of Burntisland (*J. Bennie*); Pettycur, Fife.

Haddingtonshire: Long-Craig Bay, 1½ mile west of Dunbar.

Linlithgow: Shore, E. and W. of Society, Hopetoun; Queensferry (*J. Bennie*); Shore, Dalmeny, E. of Newhall Pier (*J. Bennie*); Dalmeny (*Dr. Macfarlane*); Shore, near Long-Craig Pier, Dalmeny (*J. Bennie*).

Midlothian: Raw Camps, near Midcalder; Juniper Green (*T. Henderson*); Shore, Wardie; Craigleith Quarry (*T. Allan*); Addiewell, West Calder; Burdiehouse, near Edinburgh; Granton (*J. Gaul*); Water of Leith, Spylaw House, Colinton (*J. Bennie*); Hailes Quarry, near Edinburgh; Woodhall, Water of Leith, near Juniper Green (*J. Bennie*); Straiton Oil Works, near Loanhead; Shale over shell-bed, Railway-cutting, 300 yards N. of canal, Murchiston, Edinburgh (*J. Bennie*); Railway-cutting, Water of Leith, between Slateford and Colinton (*J. Bennie*); Straiton Brick-works, near Loanhead, West Calder.

ENGLAND—From Rocks of Calciferous-Sandstone Age*.

Northumberland: Chirden Burn, near Hope House, North Tynedale, specimen loose in drift (*H. Miller*); Alnwick Moor (*G. Tate*); Yate Burn, 2 miles S.S.W. of High Long House; Chattlehope Burn, 2 miles S.W. of Chattlehope House, Rede Water (*T. Rhodes*); near Chillingham (*Mus. N. H. Soc. of Northumberland, Durham, and Newcastle-on-Tyne*).

* The Calciferous Sandstones of the border counties are now looked upon by the Geological Survey as being the equivalent of part of the Carboniferous Limestone of Derbyshire and Yorkshire. The Scottish "Carboniferous-Limestone series" represents the Yoredale rocks of the North of England.

England.	*Scotland.*
Lower Carboniferous.	
Yoredale rocks	Carboniferous-Limestone series.
Carboniferous Limestones of Yorkshire and Derbyshire.	Calciferous-Sandstone series.
Devonian.	
Devonian (Old Red Sandstone)	Old Red Sandstone.

SIGILLARIA, Brongniart, 1822.

[Sur la classification et la distribution des végétaux fossiles, p. 9.]

Section *Clathrariæ.*

Sigillaria discophora, König, sp. (Pl. IV. fig. 5; Pl. V. fig. 8; Pl. VII. figs. 12, 13.)

Lepidodendron discophorum, Bronn, Index palæont. p. 650; König. Icones fossilium sectiles, pl. xvi. fig. 194 (1825).

Ulodendron majus, Bronn, Index palæont. p. 1341; Carruthers, Monthly Micr. Journ. vol. iii. p. 153, pl. xliii. fig. 4 (1870); Giebel, Deutschl. Petrefacten, p. 82; Goldenberg, Flora saræpontana fossilis, Heft i. p. 18; Lesquereux, Geol. Survey of Illin. vol. iv. p. 435; id. Geol. of Pennsylv. vol. ii. p. 875; id. Coal Flora of Pennsylv. p. 401 (? pl. lxvi. fig. 3) (excl. refer. Steinhauer); Lindley & Hutton, Foss. Flora, vol. i. pl. v. (excl. refer.); Renault, Cours d. botan. foss. p. 50, pl. xi. fig. 3 (1882); Röhl, Foss. Flora d. Steink. Form. Westph. p. 138; Schimper, Traité d. paléont. végét. vol. ii. p. 41 (syn. and refer. in part); Sternberg, Vers. ii. p. 185; Unger, Syn. plant. foss. p. 134; id. Genera et Species, p. 263.

Ulodendron minus, Bronn, Index palæont. p. 1341; Carruthers, Monthly Micr. Journ. p. 225, pl. xxxi. (1869); id. ibid. vol. iii. p. 153 (1870); Eichwald, Urwelt Russlands, Heft i. p. 82; Giebel, Deutschl. Petrefacten, p. 82 (excl. syn.); Goldenberg, Flora saræpontana fossilis, Heft i. p. 18; Lindley & Hutton, Foss. Flora, vol. i. pl. iv. (excl. refer.); Lesquereux, Coal Flora of Pennsylv. p. 403 (? pl. lxvi. fig. 1); Renault, Cours d. botan. foss. p. 50, pl. xi. fig. 2 (1882); Röhl, Foss. Flora d. Steink. Form. Westph. p. 139 (excl. syn.); Schimper, Traité d. paléont. végét. vol. ii. p. 42 (syn. in part); Sternberg, Vers. ii. p. 185, pl. xlv. fig. 5; Unger, Syn. plant. foss. p. 135 (excl. refer. Allan & Brongt.); id. Genera et Species, p. 263 (excl. refer. Allan & Brongt.); Zeiller, Végét. foss. du terr. houil. p. 115.

Bothrodendron punctatum, Bronn, Index palæont. p. 173; Goldenberg, Flora Saræpontana fossilis, Heft i. p. 18; Lindley & Hutton, Foss. Flora, vol. ii. pls. lxxx. & lxxxi.; Morris, Trans. Geol. Soc. 2nd ser. vol. v. p. 489; Renault, Cours d. botan. foss. p. 52, pl. xi. fig. 4 (1882).

Ulodendron punctatum, Schimper, Traité d. paléont. végét. vol. ii. p. 42.

Ulodendron Lindleyanum, Lesquereux, Geol. of Pennsylv. p. 875 (1858); Sternberg, Vers. ii. p. 185, pl. xlv. fig. 4; Unger, Syn. plant. foss. p. 135; id. Genera et Species, p. 263.

Ulodendron ellipticum, Röhl, Foss. Flora d. Steink. Form. Westph. p. 139, pl. xxiii. fig. 3 (? fig. 4).

Ulodendron Stockesii, Buckland, Geol. & Mineral. vol. ii. p. 93, pl. lvi. fig. 5; Carruthers, Monthly Micr. Journ. vol. iii. p. 152, pl. xliv. fig. 3.

? *Ulodendron Conybearii*, Buckland, Geol. & Mineral. vol. ii. p. 94, pl. lvi. fig. 6′.

?? *Ulodendron transversum*, Carruthers, Monthly Micr. Journ. vol. iii. p. 153, pl. xliv. fig. 2.

Ulodendron pumilum, Carruthers, Monthly Micr. Journ. vol. iii. p. 152, pl. xliii. fig. 2.

Ulodendron Lucasii, Buckland, Geol. & Mineral. vol. ii. p. 93, pl. lvi. fig. 4.
Lepidophloios parvus, Dawson, Acad. Geol. 2nd ed. p. 470, fig. 170 *g* (1868); id. Quart. Journ. Geol. Soc. vol. xxii. p. 163, pl. xi. fig. 50; id. Canad. Natur. vol. viii. p. 453; id. Quart. Journ. Geol. Soc. vol. xxx. p. 216; id. Foss. Plants of Lower Carb. & Millstone Grit of Canada, p. 38.
Lepidophloios tetragonus, Dawson, Acad. Geol. 2nd ed. p. 490, fig. 170 *d* (1868); id. Quart. Journ. Geol. Soc. vol. xxii. p. 164, pl. x. fig. 49; id. Canad. Natur. vol. viii. p. 453; id. Foss. Plants of Lower Carb. & Millstone Grit of Canada, p. 37.
Lepidodendron salebrosum, Wood, Trans. Amer. Phil. Soc. vol. xiii. p. 345, pl. viii. fig. 6.
Halonia disticha, Morris, Trans. Geol. Soc. 2nd ser. vol. v. p. 489, pl. xxxviii. fig. 1.
Sigillaria Preuiana, Römer, Palæontographica, vol. ix. p. 42, pl. xii. fig. 7 (1862).
Sigillaria perplexa, Wood, Trans. Amer. Phil. Soc. vol. xiii. p. 345, pl. viii. fig. 7.
Sigillaria Menardi, Lesquereux, Geol. Survey of Illin. vol. ii. p. 450, pl. xliii.

Description. Leaf-scars rhomboidal, contiguous, their transverse diameter slightly greater than their vertical diameter, placed on slightly elevated cushions, whose size but little exceeds that of the leaf-scar. Upper and lower angles of leaf-scar rounded, lateral angles sharp and prominent. Vascular impressions situated towards the upper part of the leaf-scar; central punctiform, the two lateral lunate. Certain branches bear two opposite vertical rows of large (Ulodendroid) scars, those of one row alternating in position with those of the corresponding vertical row. Large scars more or less oval, usually touching each other. Bark generally fissured longitudinally, especially in older examples. Decorticated branches also exhibit longitudinal fissures and show on their surface small "dots" arranged in quincuncial order. Leaves single-nerved, grass-like. Fructification (sessile?) cones attached to the vertical rows of large scars.

Remarks. I have found associated with this species peculiar (sessile?) cones (at least I have never seen them attached to stems or twigs), which I believe to be the fructification of this species. They appear to differ from the cones of *Lepidodendron*, and are the same as those figured by Brongniart (Hist. d. végét. foss. vol. ii. pl. xxii. figs. 2, 3, and 8*).

As far as known to me, the ramification of this species has not been observed, nor yet the termination of the branches.

This species was first figured as a *Lepidodendron*, without any description, by König, about 1825. Bronn is the only

* On the fructification of *Sigillaria*, see Zeiller, Ann. des Sci. nat. 6e sér. Bot. vol. xix. p. 256.

author, as far as I am aware, who takes any notice of König's plate, which is very characteristic of the species. A plaster cast of the specimen he figured is preserved in the collection of the British Museum; it measures 6½ inches long and 3 inches wide, and bears two perfect Ulodendroid scars and a portion of a third one. These are about two inches in diameter. The rhomboidal leaf-scars are seen in the figure, and a separate drawing of them is also given, but they show no trace of the vascular-bundle "dots."

This, like all König's figures, is extremely characteristic of the species, and is one of the best representations of the plant with which I am acquainted.

Lindley and Hutton's *Ulodendron majus* agrees in all respects with this figure, which evidently must have been unknown to the authors of the 'Fossil Flora,' as they make no reference to it. In regard to Lindley and Hutton's plate, the leaf-scars appear to be a little roughly drawn, their upper angle being too acute and the boundary-lines of the lower portion of the leaf-scar too convex. Their reference to Rhode's pl. iii. fig. 1 must be excluded, as Rhode's figure belongs to *Lepidodendron Veltheimianum* and not to their *Ulodendron majus*.

From the examination of numerous specimens, many of which were in exquisite preservation, there can remain no doubt that *Ulodendron minus*, L. & H., is only a slightly younger stem of *Ulodendron majus*, L. & H. The reference they give to Allan's plate of the *Ulodendron* from Craigleith Quarry, as synonymous with their *Ulodendron minus*, must also be cancelled, as Allan's plant is likewise *Lepidodendron Veltheimianum*, Sternberg. I have carefully examined the counterpart of the type of *Ulodendron minus*, L. & H., which is now all that is known to exist of the fossil, and am assured by the shape of the leaf-scars that it is Sigillarian, they being in fact of the same form as that described by Römer in *Sigillaria Preuiana*; but this point will be more fully discussed presently*. The figure of *Ulodendron minus*, given by Lesquereux in the 'Coal Flora of Pennsylvania,' and which appears to be inverted, is not very satisfactory, but is probably Lindley and Hutton's plant. The same author gives an excellent figure of *Sigillaria discophora*, König, sp., in the Geol. Survey of Illinois, vol. ii. p. 450, pl. xliii., under the name of *Sigillaria Menardi*, where the character of the leaf-scar is clearly shown. The specimen he figures has been a comparatively old stem, but is very characteristic of the species. In fact Lesquereux here notices the Sigillarian nature of his

* See p. 256.

fossil, and places it in the correct genus, but perhaps not under the right species, though I am by no means sure that *Sigillaria Menardi*, Brongniart (Hist. d. végét. foss. pl. clviii. fig. 5, not fig. 6), does not belong to *Sigillaria discophora*.

It is a little uncertain if the figure given as *Ulodendron majus* by Lesquereux in his 'Coal Flora,' pl. lxvi. figs. 3 & 3 *a*, belongs to Lindley and Hutton's plant. The explanation of the figures is, I am afraid, inaccurate, if they belong to the species under which he has placed them. He appears to have had under consideration two distinct plants. Perhaps his fig. 3 *a* is the *Bothrodendron punctatum*, Zeiller *, which is not, however, the *Bothrodendron punctatum* of Lindley and Hutton †. The *Bothrodendron punctatum*, Lindley and Hutton, is only a decorticated condition of their *Ulodendron majus* and *U. minus*. The plant which Zeiller has figured and identified as Lindley and Hutton's *Bothrodendron punctatum* is a closely allied species to *Rhytidodendron minutifolium*, Boulay ‡, and it is interesting to find the large Ulodendroid scars also occurring in Boulay's genus *Rhytidodendron*.

Ulodendron punctatum, Sternberg, Vers. ii. p. 186, pl. xlv. fig. 1.—As this specimen is decorticated it is impossible to determine the species to which it should be referred, though, from the closeness of the foliar vascular bundles to each other, it probably belongs to the Sigillarian group of *Ulodendron*. Even in decorticated conditions of the so-called *Ulodendra*, if the little "dots" of the foliar-vascular bundles are shown, there can be made in many cases a probable determination as to whether the specimen belongs to the Lepidodendroid or Sigillarian group of *Ulodendron*, for on the Lepidodendroid members the leaf-scars are larger than on the Sigillarian, and consequently the foliar-vascular-bundle "dots" on decorticated stems of Sigillarian *Ulodendra* stand nearer to each other than they do on Lepidodendroid *Ulodendra*. This is not, however, in all cases a secure generic test, and in no case will it lead to a specific determination. When the little "dots" are not shown, it is impossible even to say to which genus a Ulodendroid fossil belongs.

Ulodendron ellipticum, Sternberg, Vers. ii. p. 186, pl. xlv. fig. 2, does not admit of any satisfactory allocation. *Ulodendron ellipticum*, Röhl (*l. c.*), pl. xxiii. fig. 3, appears to be referable to *Sigillaria discophora*; but his fig. 4 of the same

* Ann. des Scienc. nat. 6e sér. Botan. vol. xiii. p. 218, pl. ix. figs. 1–3, and Végét. foss. du terr. houil. p. 116.

† See *antè*, pp. 138 and 174.

‡ Boulay, Terr. houil. du nord de la France et ses végét. foss. p. 39, pl. iii. figs. 1, 1 *bis*.

plate is too indifferently preserved to speak of with any certainty. Neither can any definite identification be made of *Ulodendron Lindleyana*, Röhl (*l.c.*), p. 138, pl. xxiii. figs. 1, 2. Nor can one speak with more certainty as to the specific designation of *Ulodendron Schlegelii*, Eichwald, 'Lethæa Rossica,' vol. i. p. 138, and 'Urwelt Russlands,' Heft i. p. 81, pl. iii. fig. 4.

Ulodendron transversum, Carruthers (*l. c.*) (not Eichwald) (which does not, in the few characters that the fossil shows, appear to differ from *Ulodendron Schlegelii* and *Ulodendron Conybearii*, Buckland), is also probably to be referred to *Sigillaria discophora*. Of course, in discussing the nature of *Ulodendron*, absolutely nothing for the elucidation of its true affinities can be learnt from such examples as those just mentioned, though, if at all possible, one is naturally anxious to correlate them with the species of which they are decorticated examples.

The small figure which Buckland gives of his *Ulodendron Lucasii* is not all that could be desired for a satisfactory determination; but from the form of the few leaf-scars, as shown in his figure, there is little reason to doubt that this species should also be placed under *Sigillaria discophora*.

I am unable to discover any point by which *Ulodendron pumilum*, Carruthers, can be distinguished from *Sigillaria discophora*. The specimen from which Mr. Carruthers's figure is taken is in the collection of the British Museum, and shows very well the Sigillarian form of the leaf-scars. This fossil is somewhat smaller in all its parts than König's example, but this difference is entirely dependent on age. A figure agreeing in all essentials with that of Mr. Carruthers, and which I also refer to *Sigillaria discophora*, had previously been published by Dawson in his 'Acadian Geology,' 2nd ed. fig. 170 G, p. 455 (1868), under the name of *Lepidophloios parvus*. What I believe to be only an older state of *Lepidophloios parvus* is the *Lepidophloios tetragonus*, also figured by Dawson on p. 455 of the same work, and in the Quart. Journ. Geol. Soc. vol. xxii. pl. x. fig. 49 (see Pl. VII. fig. 13 *a* *).

Halonia disticha, Morris (*l. c.*), must also be united with *Sigillaria discophora*. Specimens preserved "in the round," similar to his figure, are by no means uncommon. The presence of only two rows of large scars on his fossil is sufficient to remove it from *Halonia* (= *Lepidophloios*), and the other characters of the specimen show its true place to be here.

Geinitz, in his Verst. d. Steinkf. in Sachsen, p. 38, appears to have misunderstood the true nature of Lindley and Hutton's

* See also *ante*, p. 178.

genus *Bothrodendron*, for, under the name of *Halonia punctata*, he includes different plants.

Lepidodendron salebrosum and *Sigillaria perplexa*, Wood, are only fragments of *Sigillaria discophora*.

Both in *Sigillaria perplexa* and in the figure given under the name of *Sigillaria Menardi* by Lesquereux, the longitudinal clefts which appear in the bark of old examples are well seen. A similar vertical splitting of the bark also takes place in the succeeding species (*Sigillaria Taylori*, Carruthers, sp.), and has already been pointed out as occurring in *Lepidodendron Veltheimianum*.

One of the most interesting figures of this species has been given by Römer in the 'Palæontographica,' vol. ix. pl. xii. fig. 7, under the name of *Sigillaria Preuiana*. He says of his plant, on p. 42:—"The leaf-cushions stand, as in *Lepidodendron*, in oblique rows; they are rhomboidal or six-sided, as long as broad, slightly elevated, and show above the middle a round scar, on each side of which are two semilunar scars. The leaf-scar is almost as large as the leaf-cushion." I have seen many well-preserved specimens of *Sigillaria discophora* with the leaf-scars identical with those described by Römer as occurring in his *Sigillaria Preuiana*, and were it not for the presence of the large Ulodendroid scars on these specimens they could not have been distinguished from Römer's plant. Hence, as *Sigillaria Preuiana* agrees in all the characters that it shows with undoubted specimens of *Sigillaria discophora* we have no course left but to unite these two species. Portions of some of those examples of *Sigillaria discophora*, to which I have referred, might be broken off from those parts where the large scars do not occur and would be undistinguishable from *Sigillaria Preuiana*, Römer. I am also strongly inclined to think that *Lepidodendron pustulatum*, Boulay *, is not specifically distinct from *Sigillaria discophora*, König, sp. *Sigillaria discophora* appears to be restricted to the Coal-measures.

Localities and Horizons.

SCOTLAND—Coal-measures.

Ayrshire: Bonnington Pit, Kilmarnock (*Rev. D. Landsborough.*

Clackmannanshire: Devonside, Tillicoultry (*T. Mitchell*); Furnace Bank Colliery, Old Sauchie.

Lanarkshire: "Airdrie Coal Field" (*Hunterian Museum, Glasgow*); near Carluke (*collection of British Museum*); Shotts (*ditto*); Shettleston (*R. Dunlop*).

Perthshire: Blairingone Colliery, $1\frac{3}{4}$ mile S.E. of Dollar.

* Boulay, Le terr. houil. du nord de la France et ses végét. foss. p. 37, pl. ii. figs. 2, 2 *bis*. Lille, 1876.

ENGLAND—Coal-measures.

Durham: High Main Seam, South Shields (*Type of* U. minus, *Hutton collection*).

Northumberland: Bensham Seam, Jarrow (*Type of* U. majus, *Hutton collection*).

Shropshire: Coalbrookdale (*Type of* Halonia disticha, *Prof. Morris*).

Staffordshire: Longton (*J. Ward*); Low Moor (*collection of British Museum*).

Worcestershire: Bewdley (*collection of British Museum.*)

Yorkshire: Boldshaw, Bradford Moor, Bradford (*collection of British Museum*); Wakefield (*ditto*).

Sigillaria Taylori, Carruthers. (Pl. IV. figs. 6, 6 *a*; Pl. V. fig. 9; Pl. VI. figs. 10, 10 *b*, *c*, *d*.)

Ulodendron Taylori, Carruthers, Monthly Micr. Journ. vol. iii. p. 152, pl. xliii. fig. 1 (1870).

Ulodendron minus, Thompson, "On *Ulodendron* and *Halonia*," Trans. Edinb. Geol. Soc. vol. iii. p. 341, pl. (B).

Lepidodendron Veltheimianum, Stur (in part), Culm Flora, pl. xxxix. figs. 1, 2.

Sigillaria, sp., Kidston in Cadell, Trans. Edinb. Geol. Soc. vol. iv. p. 335.

Description. Branches dichotomizing; leaf-scars small, rhomboidal, contiguous, their transverse and vertical diameters being almost equal. Leaf-scars placed on slightly elevated cushions, whose size little exceeds that of the leaf-scar; upper and lower angles of leaf-scar rounded, lateral angles sharp, but scarcely produced. Vascular impression situated towards the upper part of the leaf-scar. Certain branches bear two opposite vertical rows of large (Ulodendroid) scars, those of one row alternating in position with those of the corresponding vertical row. Large scars circular, occasionally oval, usually separated by a slight interval, but sometimes touching each other. Bark generally fissured by longitudinal clefts. Large scar-bearing branches ending in a truncated apex. Decorticated specimens also exhibit the longitudinal fissures and show on their surface small "dots" arranged in quincuncial order. Leaves single-nerved, lanceolate. Fructification (sessile?) cones attached to the vertical rows of large scars.

Remarks. This species is much smaller in all its parts than *Sigillaria discophora*, nor do its branches appear to have attained the same magnitude as those of the last-mentioned species. The leaf-scars also are more truly rhomboidal.

The form of the leaf-scars is not well shown in the type specimen of this species, but they are better shown in the three other figures of this plant, which have been given under the

names of *Ulodendron minus* and *Lepidodendron Veltheimianum*.

It is difficult to understand how Dr. Stur has included his two figures of *Sigillaria Taylori* under *Lepidodendron Veltheimianum*, as no state of preservation or age could account for the leaf-scars of *Lepidodendron Veltheimianum* becoming so altered as to assume the form and arrangement shown in his 'Culm Flora,' pl. xxxix. figs. 1, 2. His fig. 1 shows an older condition of *Sigillaria Taylori* than his fig. 2. The right-hand upper corner of this last-mentioned figure indicates clearly the Sigillarian form of the leaf-scar, and how close the affinities of this species are with *Sigillaria discophora*. Mr. D'Arcy Thompson has figured an example of this species (*Ulodendron minus*, l. c.) with the lower portion of the appendicular organ attached. The Clathrarian form of the leaf-scars is well shown in his figure, but even better on his specimen, which he has kindly lent me for examination.

I have already given a description of an example of this species (No. 18), collected by Dr. Macfarlane, which shows the appendicular organs in a young condition, attached to the stem (Pl. V. fig. 9).

This species is restricted to the Lower Carboniferous (Carboniferous-Limestone series and Calciferous-Sandstone series).

Localities.

SCOTLAND—From the Carboniferous-Limestone Series.

Linlithgowshire: Blaes, 20 ft. above Parrot Seam, No. 6 Pit, Grange, Bo'ness (*H. M. Cadell*); Silver-Mine Quarry, Linlithgow (*H. M. Cadell*); Bathgate (*type of species in the collection of the British Museum*).

From the Calciferous-Sandstone Series.

Midlothian: Camps Lime Quarry, near Midcalder (*R. F. B. Bishop*); Straiton, near Loanhead; Addiewell; West Calder; Midcalder.

I conclude by thanking the friends who have so kindly and willingly submitted to me for examination many specimens, which have been of the greatest use while drawing up these notes.

EXPLANATION OF THE PLATES.

PLATE III.

Fig. 1. *Lepidodendron Veltheimianum*, Sternberg. From Burghlee, Loanhead, Midlothian. Calciferous-Sandstone series. Natural size. (Specimen No. 1.)

Plate IV.

Fig. 2. *Lepidodendron Veltheimianum*, Sternberg. From the Oil Shales, West Calder, Midlothian. Specimen in the collection of the Addiewell Oil Co., Addiewell, Midlothian. Calciferous-Sandstone series. Natural size. (Specimen No. 3.)

Fig. 3. *Lepidodendron Veltheimianum*, Sternberg. From Dalmeny, Linlithgowshire. Calciferous-Sandstone series. Natural size. Specimen collected by Dr. Macfarlane, Edinburgh. (Specimen No. 4.)

Fig. 4. *Lepidodendron Veltheimianum*, Sternberg. From West Calder, Midlothian. Calciferous-Sandstone series. Natural size. (Specimen No. 5.)

Fig. 5. *Sigillaria discophora*, König, sp. From Furnace-Bank Pit, Old Sauchie, Clackmannanshire. Coal-measures. Natural size. (Specimen No. 15.) 5 *a.* A few leaf-scars from fig. 5, enlarged.

Fig. 6. *Sigillaria Taylori*, Carruthers, sp. From Camps Lime Quarry, Midcalder, Midlothian. Calciferous-Sandstone series. Natural size. (Specimen No. 16.) Collected by the late R. F. B. Bishop, Esq., Edinburgh. 6 *a.* A few leaf-scars from fig. 6, enlarged.

Fig. 7. *Sigillaria Brardii*, Brongniart. A few leaf-scars copied from Brongniart (Hist. d. végét. foss. pl. clviii. fig. 4).

Plate V.

Fig. 8. *Sigillaria discophora*, König, sp. From "Coal-measures, British." Specimen in the collection of the Geological Survey of Great Britain, Museum of Practical Geology, London. Natural size. (Specimen No. 13.)

Fig. 9. *Sigillaria Taylori*, Carruthers, sp. From Calciferous-Sandstone series. Natural size. (Specimen No. 18.)

Plate VI.

Fig. 10. *Sigillaria Taylori*, Carruthers, sp. From the Oil Shales, near Addiewell, Midlothian. Calciferous-Sandstone series. $\frac{1}{3}$ natural size. (Specimen No. 17.) In the collection of the Addiewell Oil Co. 10 *b.* Small portion of stem, natural size, marked *b* on fig. 10. 10 *c.* Ulodendroid scar marked *c* on fig. 10, natural size. 10 *d.* Small portion of stem, marked *d* fig. 10, showing the *Bothrodendron*-condition of the plant.

Fig. 11. *Lepidodendron Veltheimianum*, Sternberg. From Blackbraes, West Calder, Midlothian. Calciferous-Sandstone series. $\frac{1}{3}$ natural size. (Specimen No. 6.) Collected by J. Linn, Esq. 11 *a.* A few of the leaf-scars, marked *a*, fig. 11, natural size. 11 *b.* Profile view of appendicular organ, which fits into the depressed Ulodendroid scar of fig. 11, natural size. 11 *c.* Basal view of appendicular organ, natural size.

Plate VII.

Fig. 12. *Sigillaria discophora*, König, sp. From Devonside, Tillicoultry, Clackmannanshire. Coal-measures. Natural size. (Specimen No. 12.) Collected by Mr. T. Mitchell, Tillicoultry. 12 *a.* A few leaf-scales from part marked *a*, fig. 12, enlarged. 12 *b.* A few leaf-scars from part marked *b*, fig. 12, to show variation in form of leaf-scar, enlarged.

Fig. 13. *Sigillaria discophora*, König, sp. From Furnace-Bank Pit, Old Sauchie, Clackmannanshire. Coal-measures. (Specimen No. 14.) $\frac{1}{4}$ natural size. 13 *a*. A few leaf-scars, natural size. 13 *b*. Small portion of fig. 13, showing *Bathrodendron*-condition, natural size.

Fig. 14. *Lepidophloios scoticus*, Kidston. From West Calder, Midlothian. Calciferous-Sandstone series. *a*, articulating leaf-surface; *g*, downward-directed cortical cushion.

Fig. 15. *Lepidodendron aculeatum*, Sternberg. Leaf-scar, to show its various parts: *a*, vascular scar or impression; *b*, vascular-bundle impression; *c c*, the "field;" *d d*, oval pits; *e*, "ligule" depression; *f*, medial line.

XXV.—*Chilomonas paramœcium*. By Sara Gwendolen Foulke *.

[Plate IX. B. figs. 1-6.]

Since its discovery by Ehrenberg this form has been carefully studied by Bütschli, Stein, and Kent, the two latter giving the first entirely accurate diagnosis of its character.

According to Kent *Chilomonas* is classified as follows:—Order Flagellata-Eustomata; Family Chilomonadidæ; Genus *Chilomonas*.

Fig. 1, Pl. IX. B, represents the form so accurately that no detailed description is necessary.

Bütschli states that this animalcule, when isolated for observation, quickly loses its normal contour, and becomes spherical, finally disintegrating.

While I was investigating a drop of water teeming with *Chilomonas* a minute flagellate amœboid form (fig. 2) entered the field, and after swimming uncertainly about for some moments, settled to the bottom of the live-box, where it moved in amœboid fashion, the two flagella becoming merged in the pseudopodium-like processes. The presence of about twenty small highly refractive bodies, suspected to be germs, was noticed. Soon the mass became so diffused as to form a mere film, and presently disintegrated, setting free these bodies, which swam away. Several similar individuals were found, some of which, on becoming quiescent, took a globular shape, retaining both flagella to the last. This sphere then grew larger and its wall thinner, until, like a bubble, it burst, liberating the germs, which were always present and very

* From the 'Journal of the New-York Microscopical Society.'

active (fig. 3). So many of these forms were now found, while the number of the adult forms of *Chilomonas* at the same time diminished, that the identity of the two was suspected; and the suspicion was verified almost immediately by my witnessing the transformation throughout.

An individual would begin to spin round, gradually losing contour, while the refractive "corpuscles" ranged near the cell-wall left their places and moved actively about, showing, as did also the increased transparency of the cell, incipient liquefaction of the endoplasm. An amœboid character was now assumed, until, finally, one or the other of the two phases above noted was entered upon. When the final shape was that of fig. 4, the freeing of the germs was effected in various ways. Sometimes, as stated, the film became generally disintegrated; in other cases one large external vesicle was formed, leaving only a very small portion of protoplasm enclosing the germs, and from this the germs energetically freed themselves after the bursting of the vesicle (fig. 5). In still others a small vesicle formed about the germs, and, moving to the cell-wall, extruded itself and burst, liberating the germs directly into the water, after which the remainder of the animalcule disintegrated (fig. 6).

In from four to five days each of these germs developed into an adult *Chilomonas*, having the characteristic form at an early stage of growth. The "corpuscles," or, correctly, the germs, appeared in these at maturity.

The habit of breaking up, as recorded by Bütschli, probably coincides with the above phenomena; and although that author does not describe the liberation of germs, I believe this habit to exist principally for that purpose, as the young or recently matured *Chilomonas* was not affected by confinement. This, then, seems to be the first time that the true character of the ornamental belt of so-called corpuscles has been indicated.

The transition to the globular and the amœboid phases afforded strong corroboration of the opinions of Stein and Kent, as opposed to that of Bütschli, regarding the point of growth of the flagella—showing them to be inserted close together.

XXVI.—*Report on the Testaceous Mollusca obtained during a Dredging-excursion in the Gulf of Suez in the Months of February and March* 1869. By ROBERT MACANDREW.—*Republished, with Additions and Corrections, by* ALFRED HANDS COOKE, M.A., Curator in Zoology, Museum of Zoology and Comparative Anatomy, Cambridge.—Part III.

[Continued from vol. xvi. p. 50.]

Shell.	Station.	Distribution.	Remarks.
TURBINIDÆ.			
Phasianella Brongniarti, *Aud.* [=splendida, *Phil.*].	Shore, not unfrequent.	....	These specimens and the species as a whole are to be identified with *splendida*, Phil., from which they have no satisfactory point of distinction. Audouin was a terrible species-maker, and apparently had very little access to the literature of his subject. The colour of these specimens is remarkable, being exactly that of Küster's fig. 12 of *Ph. rubens*, Lam., with which, of course, *splendida* has no connexion. The parallel ruled lines are coloured according to their under surface, and are milk-white on the flammulous opaque patches.
—— splendida, *Phil.*	2–6 fath.; rare.	Red Sea.	
—— lineolata, *Wood* [=variegata, *Lam.*].	Not unfrequent, 2–6 fath.	Mauritius. [Zanzibar, Ceylon, Philippines, New Caledonia, Cape York.]	Here again not only must these specimens, but the species as well, be merged in *variegata*, Lam., as identified by Küster, if that identification be correct. Reeve (Conch. Ic.) confesses his inability to make out the Lamarckian shell, nor does he admit *lineolata*. His *nivosa* appears to correspond to both these forms, and should therefore, if Küster's identification be accepted, disappear altogether. I suspect too that Reeve's

			jaspidea (Zanzibar) will hardly avoid the same fate. Issel (Mar Rosso, p. 216) finds it at Suez. The species-makers have run riot in this most variable genus.
—— variegata, *Lam.*	2–6 fath.; frequent.	Australia, *Persian Gulf.	
Turbo petholatus, *L.*	Shore, dead; Ras Mahommed.	Philippines. [Ceylon, Torres Straits.]	
—— Reevii, *Phil.* ? [petholatus, *L.*]	One specimen, small; shore, dead, Ras Mahommed.	....	A very young, broken, and worn specimen of the common *petholatus*, L.
—— pustulatus, *Broc.* [*Reeve*] [granosus, *Gray*].	Two specimens; shore, dead.	....	Wrongly identified; the shells, two very bad specimens, are more like *granosus*, Gray (Brit. Mus.).
—— arsinoensis, *Issel* [Collonia armillata, *A. Ad.*].	One specimen, shore.	....	The shell is not a *Turbo* at all, but a small specimen of *Collonia armillata*, A. Ad.
—— Chemnitzianus, *Reeve* [=chrysostoma, *L.*].	Low water, abundant.	Red Sea.	I am not able to separate this from the form recognized as *chrysostoma*, L. The species, as is usual with *Turbo*, varies according to its station in size and in the lamination of the ribs, which are sometimes very prickly, sometimes nearly smooth. *Turbo saxosus*, Wood, which I have collected by hundreds at Panama, presents exactly the same features of variation. *Histrio*, Reeve (Conch. Ic. vol. iv. *Turbo*, fig. 32), and *speciosus*, Reeve (*ib.* fig. 35), and probably *ticaonicus*, Reeve (P. Z. S. 1842, p. 185), are synonyms, and possibly yet other of Reeve's Cumingian "species."
Collonia armillata, *A. Ad.*	Not frequent.	Australia.	
Cyclostrema cingulifera, *A. Ad.*	Nine specimens.	[Isle of Negros, Japan.]	
Morchia obvoluta, *A. Ad.*	Two specimens.	Japan.	
Umbonium roseum, *Lam.*..	One specimen, dead.	Indian Seas, Persian Gulf.	

* Species and localities thus labelled are added to the original list in MacAndrew's own handwriting.

Shell.	Station.	Distribution.	Remarks.
Umbonium *striolatum, *A. Ad.*	[Fourteen specimens], 10–20 fath.	....	This is the "*Ethalia*, sp."
Isanda Emprichii, *Issel* ..	Frequent; on shore.		
Cardinalia virgata, *Gmel.*	Shore, not frequent.	East Indies.	
Tectus dentatus, *Forsk.* ..	Low water, abundant.	Red Sea.	
Polydonta erythræa, *Broc.*	Abundant, low water.	....	Rightly identified; the shell is well figured in Küster. Surely the Brit. Mus. is wrong in labelling specimens of this shell "*radiatus*, Chemn."
Clanculus pharaonis, *L.* ..	Shore, dead; Zeite Point, &c.	Red Sea. [Aden.]	
Monodonta dama, *Phil.* [=australis, *Lam.*, var.].	Low water, abundant.	Red Sea. [Natal.]	Cannot be kept distinct from *australis*, Lam. The colouring varies immensely in the forty specimens before me; some are pink, with rose-coloured interrupted lines, others green and fawn, with brown lines, others almost black; another variety is quite destitute of the interrupted bands, which might be thought a necessary characteristic of the species.
—— obscura, *Wood*	Not rare; 2–5 fath.	Natal.	
Euchelus foveolatus, *A. Ad.*	Rare; 8–10 fath.		
—— exasperatus, *A. Ad.*	One specimen.		
Perrinea stellata, *A. Ad.* ..	Rare; 8–10 fath.	*Persian Gulf.	
Zizyphinus fragum, *Phil.* ..	One specimen.	Australia.	
*Minolia Holdsworthii, *Nev.*	Twenty-five specimens.	....	To this species belong all the specimens denoted by "*Margarita*, ? sp., undetermined."
Solariella scalariformis, *Sow.* [solariformis].	....	....	Possibly correct; but there is only one bad specimen.
Forskalia declivis, *Forsk.* ..	Frequent; shallow water.	Red Sea.	
Stomatia duplicata, *Sow.* ..	Rare; living in 8–10 fath.	Philippines, *Persian Gulf.	
—— phymotis, *Helb.*	Frequent on shore, dead; living in 5 fath.	Philippines.	About twenty-five specimens in all.
Stomatella arabica, *A. Ad.*	One specimen.		

—— *modesta, *H. & A. Ad.*	[One specimen.]		
—— scitula, *H. Ad.*	[Two specimens.]		
Gena lutea, *Lam.*	Not unfrequent.	Eastern Seas.	
—— nigra, *Quoy*	Two specimens.	Sandwich Is.	
—— varia, *A. Ad.*	A few specimens.	Philippines.	
Haliotidæ.			
Haliotis scutulum, *Reeve* [=varia, *L.*, var.].	Not unfrequent on shore; dead.	[Ceylon, Philippines, Torres Straits.]	Manifestly a variety of *varia*, L. I since see that Weinkauff (in Küster, Monogr. of *Haliotis*) agrees with this union, and further regards *viridis*, Reeve, *ustulata*, Reeve, *relevata*, Desh., and *pertusa*, Reeve, as mere local varieties of the variable *varia*, L. Perhaps to these may be added *astricta*, Reeve, and *rugosa*, Reeve.
Ianthinidæ.			
Ianthina bifida, *Nutt.*	Shore, dead.	Pacific Ocean.	
Solariidæ.			
[Torinia perspectiviuncula. *Meusch.*]	[Five specimens.]	[Ceylon.]	
[Solarium cingulum, *Kien.*]	[Five specimens.]	....	On the same card and with the same label as the preceding. The usually accepted identification of *cingulum*, Kien., with *Trochus hybridus*, L., is considered doubtful by Pease (Amer. J. of C. vol. iv. p. 125).

Shell.	Station.	Distribution.	Remarks.
RISSOIDÆ.			
Rissoina clathrata, *A. Ad.*	Two specimens; shore, Zeite Point.	Philippines, Australia.	Outer lip much more effused than in Reeve's fig. in the Conch. Icon.
—— spirata, *Sow.*	Frequent; shore, Zeite Point and Tur.	Philippines, Australia. [Djedda, Isle of Rawak.]	Reeve's figure is very bad, and does not show how the longitudinal ribbing stops abruptly at generally the last four whorls. Young specimens are ventricose as compared with older ones, and so have taken in A. Adams; see remarks on *Microstelma concinna* below.
—— tridentata, *Mich.*	Frequent; shore, Zeite Point and Tur.	Mauritius, Philippines, Sandwich Is.	Teeth often completely absent, even in full-grown specimens.
—— scalariformis, *C. B. Ad.* [plicata, *A. Ad.*].	Not rare; shore, Zeite Point and Tur.	[Philippines, Java.]	A Panama shell (Adams, Cat. of Shells of Panama, p. 140)! I do not think that any Panama shell, even *Crepidula unguiformis*, occurs in the Red Sea. Deshayes (Moll. Réun. p. 61) was the first to recognize this, wrongly I believe, as an East-Indian shell, and was followed by Liénard (Moll. Maur. p. 45). Weinkauff (in Chemn. *Rissoina*, tab. viii. fig. 7) does not seem at all surprised, and adopts the localities without remark. The ribbing of the specimens before me is absolutely distinct from that of *scalariformis*, as given in the figures of Weink.; not to mention other points, there are about fifteen ribs on each whorl, while *scalariformis* is described as having but eleven. It appears to me that they are *plicata*, A. Ad. (P. Z. S. 1851, p. 264), and to this species I believe the Mauritian *scalariformis* of Desh. and Lién. should be referred.
			Was it simply to confuse posterity that

			C. B. Ad. described *Rissoa scalarella*, *scalariformis*, and *scalaroides*, to which A. Ad. adds *scalariana*?
— Bertheloti, *Aud.* [plicata, *A. Ad.*].	Not rare; Zeite Point and Tur.	*Persian Gulf.	These specimens are the same as the preceding. They are quite distinct from *Bertheloti*, not having any sign of the "*funiculus spiralis inferne*," and being strongly, instead of *exilissime*, striated between the ribs.
— erythræa, *Phil.*	One specimen.	....	The shell is worn, and all that can be said is that the identification may be right.
Hyala nitida, *A. Ad.*	[Two specimens.]	....	Described, with the following, in Ann. & Mag. Nat. Hist. 1870, vi. p. 123.
— concinna, *A. Ad.* [=nitida, *A. Ad.*]	[One specimen.]	....	Identical with the preceding, *concinna* being the worn and lustreless, *nitida* the fresher form. Adams' attempted differences (non-perforation of axis and angulation or whorls at suture in the case of *nitida*) will not hold.
— plumula, *A. Ad.* [pumila, *Ad.*].	....	Japan, *Persian Gulf.	*Plumula* is a mere mistake for *pumila* (Ann. & Mag. N. H. 1870, p. 123).
Microstelma concinna, *A. Ad.* [=Rissoina spirata, *Sow.*, juv.].	[One specimen.]	....	"I suspect this to have been described from a worn and broken specimen of *Rissoina spirata*," notes MacAndrew, and he is quite right. It was described in the Ann. & Mag. N. H. 1870, vi. p. 121, Adams mentioning that the shell had the aspect of a Pyramidellid (of the *Myonia* type I suppose), but that the loss of the apical whorls made the genus rather doubtful. It was a terrible blunder, however, to make not merely a new species, but a new subgenus, out of a young and worn shell of a not by any means out-of-the-way *Rissoina*. Note that this species is not the *Rissoina concinna* of A. Ad. (P. Z. S. 1851, p. 266), nor the species (*pseudoconcinna*, G. Nevill,

Shell.	Station.	Distribution.	Remarks.
			vide Weinkauff in Küster) figured as *concinna*, A. Ad., in Reeve, Conch. Ic. *Rissoa*, sp. 9, nor the *Rissoa concinna* of Monterosato (Test. Nuov. Sicil. p. 8, fig. 2).
Ceratia pyrgula, *A. Ad.* ..	Two specimens.		
Corena tuberculifera, *A. Ad.*	One specimen.	....	The single specimen has unfortunately been smashed to pieces with the exception of the few top whorls.
Rissoa gracilis, *A. Ad.* ..	One specimen.	....	The name was ill-chosen, as there is a *R. gracilis* of Macgillivray (Moll. Aberdeen, p. 151), which =*striata*, Mont. The present shell is extremely elegant, the mouth being exactly half a very long oval, outer lip rather effused, a beaded line at the suture.
Onoba mirifera, *A. Ad.* [mirifica].	Four specimens.	Japan.	
Fenella pupoides, *A. Ad.* ..	Frequent.	Japan.	
—— scabra, *A. Ad.*	Frequent.	Japan, *Persian Gulf.	
—— reticulata, *A. Ad.* ..	Frequent.	Japan, *Persian Gulf.	
—— rufocincta, *A. Ad.* ..	One specimen.	Japan.	
Alaba imbricata, *A. Ad.* ..	Not rare.	Japan, *Persian Gulf.	
—— lucida, *A. Ad.*	One specimen.	Japan.	
Diala varia, *A. Ad.*	Frequent.	Japan, *Persian Gulf.	Shells rather more produced than the type, but unmistakable. Is *D. lauta*, A. Ad. (Adelaide), anything more than a large form?
—— suturalis, *A. Ad.*	One specimen.	Philippines.	
—— succincta, *A. Ad.* ..	Three specimens.		
LITTORINIDÆ.			
Xenophora solarioides, *Reeve*.	Few specimens, in 12 fath., sand.	Philippines. [N.E. Australia, Torres Straits.]	

Littorina intermedia, *Phil.* [=scabra, *L.*].	Low water, rare; Ras Mahommed, &c.	New Holland, Philippines, Tahiti. [Ceylon, Natal, S.E. Australia.]	*Intermedia* has been rightly identified with *scabra* by Weinkauff (in Chemn. Conch. Cab. 1882, p. 38), but I should hardly follow him so certainly in considering *Newcombi*, Reeve, a synonym. The more solid form and brown columella seem very distinguishing features of the latter species. It is difficult, when any number of the form *angulifera*, Lam., are compared together, to avoid the suspicion that this species graduates into *scabra*. If so, and if *angulifera* be a marked variety of *scabra*, a number of Reeve's East-Indian species (*Philippiana*, *Sieboldi*, *arboricola*) will have to follow suit.
—— millegrana, *Phil.*	Between tide-marks, rare; Ras Mahommed.	Red Sea.	
—— subnodosa, *Phil.*	Between tide-marks, abundant; Ras Mahommed.	Red Sea.	The East-Indian "analogue" of the West-Indian *dilatata*.
Modulus candidus, *Petit* [=tectum, *Gmel.* var.].	Rare, one specimen, living; on coral, 4 fath. [Five specimens in all.]	Sandwich Is. [New Caledonia, N.E. Australia.]	The species appears to me nothing more than a white variety of the well-known *Trochus tectum*, Gmel. The ribbing is very variable; sometimes in small specimens the ribs are large and angulated, at other times full-grown specimens are completely destitute of ribs on the last whorl.
Risella Sismondi, *Issel*....	Frequent; shore.		
Fossarus trochlearis, *A. Ad.* [bicarinatus, *A. Ad.*].	Shore, one specimen.	Eastern Seas. [Pegu, Burmah.]	Wrongly identified; *trochlearis* has five *cingulæ* on the last whorl, this has only two, plus the circa-umbilical band. I write *Fossarus*, not *Fossar*, in spite of A. Adams's monograph in P. Z. S. 1853, pp. 186-7. *Fossar*, as the name of a genus, offends the ear almost as much as *Vanikoro*.

Shell.	Station.	Distribution.	Remarks.
CALYPTREIDÆ.			
Calyptræa dormitoria, *Reeve.*	Two specimens, shore.	Philippines.	
Cochlolepas granulosa, *A. Ad.*	One specimen.		
Amalthea australis, *Quoy.* .	Shore to 5 fath., not unfrequent.	Australia.	Two specimens *in situ*, on a *Strombus* and a *Cerithium.*
—— conica, *A. Ad.* [australis, *Quoy*].	Two specimens.	... .	These are nothing more than rather elevated specimens of *australis.*
FISSURELLIDÆ.			
Fissurella Rüppellii, *Sow.*	Shore; frequent.	Red Sea. [Philippines.]	*Quadriradiata*, Reeve (Philippines), is a synonym. Reeve says the orifice differs; it does in the specimen he selected as the type, but in the adult form this difference disappears. Sowerby ('Thesaurus,' *Fissurella*, figs. 107, 108) unites them. The "—— sp. low water, frequent," of MacAndrew is also *Rüppellii*, in which the four dark rays are not always constant.
[—— impedimentum, *Cooke.*]	[Four specimens.]	....	*Fiss.* testâ elevatâ, albidâ, gibbosâ, perarcuatâ, æquâ fere altitudine atque longitudine, costis numerosis alterne majoribus radiatâ, liris transversis concentricis cancellatâ, apice supra marginem posteriorem, nec ultra, posito, marginibus intus valide denticulatis, foramine oblongo; altit. ·35 in., long. ·375 in. This remarkable shell is of the same type as *arcuata*, Sow. The noteworthy features are the extreme elevation, the very gibbous form, and the fact that the apex, which is not at all prominent, is almost over the margin, so that the posterior

			end of the shell is almost perpendicular. Viewed from underneath the margins form an almost complete circle.
—— megatrema, *A. Ad.*	Rare; shore, dead.	*Persian Gulf.	
Cemoria *nana, *H. Ad.*	One specimen.		
Rimula exquisita, *A. Ad.*	One specimen.	Philippines. [N.E. Australia, Torres Straits.]	
Emarginula incisura, *A. Ad.*	One specimen.	....	"The locality of this remarkable shell in the Cumingian collection is not known," says Reeve. The type (in the Brit. Mus.) and the present shell appear to be the only specimens yet discovered.
—— Cuvieri, *Aud.* [clypeus, *A. Ad.*].	Three specimens, dead.	[Singapore, Borneo, Philippines.]	Identified by Reeve (Conch. Icon. vol. xix.) with *Huzardi*, Payr., which is found in every part of the Mediterranean. Whether the identification be correct I do not venture to affirm, but the present shells are certainly not *Huzardi*. They are *clypeus*, A. Ad. (Borneo, Philippines, P. Z. S. 1851, p 83), of which *planulata*, A. Ad. (Singapore, P. Z. S. 1851, p. 86), appears to be a synonym. The types of both are in the Mus. Brit.
—— *fissura, *L.* [elongata, *Costa*].	....	....	The shells (two small specimens) thus identified are young forms of the following species. *Fissura*, L., is given in the Brit. Mus. from the Philippines; but I cannot help thinking there is some mistake.
—— *incissa, *Dillw.* [elongata, *Costa*].	[Four specimens.]	[Mediterranean generally.]	No doubt identified by MacAndrew from a tablet in the Mus. Brit., in reference to which Mr. E. A. Smith writes to me as follows:—"The *Emarg. incissa*, Dillw., of our collection is, in all probability, supposed to represent *Patella incisa*, Dillw. (p. 1054), which was founded on a figure and description in Chemn. Conch.

Shell.	Station.	Distribution.	Remarks.
			Cab. vol. xi. p. 185, t. 197. figs. 1925–6. Our shells do not, however, in my opinion, agree with that species, which, moreover, is said to be from the Falkland Is. They are the *E. elongata*, Costa (*vide* Phil. Enum. moll. Sicil. i. p. 115, t. vii. fig. 13)." This is a common Mediterranean species, and specimens collected by MacAndrew at Tunis, the Spanish coast, &c., agree exactly with these from the Gulf of Suez.
Emarginula *modesta, *H. Ad.* [? =scutellata, *Desh.*].	[One specimen.]	....	P. Z. S. 1872, p. 10, pl. iii. fig. 8; the single specimen is merely a young form of the succeeding species.
—— *rugosa, *H. Ad.* [=scutellata, *Desh.*].	[One specimen.]	....	P. Z. S. *ut suprà*, fig. 9; the shell is identical with *Cumingii*, Sow., and *scutellata* (not *scutulata*, as Reeve miscopies), Desh. Sowerby ('Thesaurus,' vol. iii.) pleads for a separation, on the ground that the apex of *Cumingii* is nearer the posterior side; but in these large and irregular *Emarginulæ* the position of the apex, if a sufficient number of specimens be examined, will be found to vary considerably in the same species.
Nesta candida, *H. Ad.*	One specimen.	....	P. Z. S. 1870, p. 6.
Hemitoma panhiensis, *Quoy* [? =australis, *Quoy*].	Shore, several varieties.	Philippines.	Here, as so often, a shell which inhabits interstices of coral, and which consequently assumes a variety of shapes according to its lodging, has been made into a number of species. I am unable to perceive anything of lasting distinction between *australis*, Quoy, which may be regarded as the typical form, and the varieties, sometimes pinched up and ele-

			vated, as *sculptilis*, A. Ad., *nodulosa*, A. Ad., sometimes spread out, as *imbricata*, A. Ad. *Panhiensis*, Quoy, is a smaller form with finer sculpture; but I doubt whether it can be kept separate.
Scutellina cancellata, *Pease*.	Three specimens, dead.	....	Wrongly identified; the species appears new; but I do not describe it at present.
—— *arabica, *Rüpp.*	[Two specimens.]		
Scutus granulatus, *Brug.* [corrugatus, *Reeve*= unguis, *L.*].	Rare; dead, Ras Mahommed.	Philippines. [Bombay, Amboina, New Ireland, China, Japan, Port Essington, Moreton Bay, N.E. Australia; Zanzibar, Cape of Good Hope.]	The sides are straight and parallel, which seems to be a characteristic of *corrugatus*, while those of *granulatus* narrow towards the anterior end. Mr. E. A. Smith (Journ. of Conch. vol. ii. pp. 253, 261) has demonstrated the identity of *corrugatus* and *unguis* in an article which deals with the whole genus in a masterly manner.
PATELLIDÆ.			
Patella rota, *Chemn.*......	Frequent between high and low water.	Mozambique. [Aden, Mauritius.]	About eighty specimens.
—— biradiata, *Reeve* [rota, *Chemn.*].	Rare, between high and low water.	China seas.	Quite wrongly identified; nothing but worn shells of *rota* in which the marking happens to have coalesced into two broad rays. The "five species, undetermined," are all *rota*.
DENTALIIDÆ.			
Dentalium bisexangulatum, *Sowb.*	One specimen.	Java. [N.E. Australia, Torres Straits.]	
—— longitrorsum, *Reeve*..	One specimen, 20 fath.	Philippines, *Persian Gulf. [Darnley I., Torres Straits.]	
—— *subtorquatum, *Fisch.*	[Six specimens.]		
—— *semipolitum, *Sow.*			
—— *minutum, *H. Ad.*			
—— Belcheri, *Sow.* [aratorum, *Cooke*].	Not rare; 10–30 fath.	....	MacAndrew perceived that *Belcheri*, Sow., was wrong, and has corrected to "*Reevii*, Desh., MSS." I have no idea what this

Shell.	Station.	Distribution.	Remarks.
			refers to, so will describe the species, which is a good one. *Dent.* testâ solidâ, pallide succineâ, acuminatâ, arcuatâ, costis modo undecim modo duodecim parum fortibus sed distinctis laqueatâ, interstitiis nec non costis ipsis longitudinaliter fortiter lineatis, lineis interstitiorum circiter quatuor, impressis; apice integro; long. 1·5 in., lat. apud basim ·15 in. Very distinct from the next species, which it nevertheless strongly resembles in its *sculpture*. This shell is more curved, the ribs are never less than eleven, and are comparatively obscure, while in *lineolatum* there are always nine, and they are very marked and prominent.
[Dentalium lineolatum, *Cooke*.]	[Seven specimens.]	....	*Dent.* testâ solidâ, pallide succineâ, acuminatâ, apicem versus curvatâ, costis novem angulatis, valde eminentibus, æquidistantibus laqueatâ, interstitiis necnon costis ipsis longitudinaliter lineatis, striisque minutissimis transversis decussatis, apice integro; long. 1·75 in., lat. apud basim ·25 in. In fresh specimens the interstitial lines are very marked; they are parallel to the ribs, which are themselves generally bisected by a similar line.
[—— acus, *Cooke*.]	[One specimen.]	....	*Dent.* testâ tenui, perangustâ, acuminatâ, politâ, subpellucidâ, parum arcuatâ, costis circiter quatuordecim, non æquidistantibus, vix elevatis sed ad basim distinctis laqueatâ, costis ad apicem coalescentibus et evanescentibus, interstitiis levibus et

			politis; long. 1·25 in., lat. apud basim ·0625 in. Probably a young shell, but very distinct from any known species. It is a most graceful shell, exquisitely marked and polished.
[—— clavus, *Cooke.*]	[Three specimens.]	....	*Dent.* testâ solidâ, albidâ, informi, leniter arcuatâ, æque fere ad apicem atque ad basim latâ, costis circiter undecim valde indistinctis laqueatâ, interstitiis longitudinaliter lineatis, lineis interdum costas fere æquantibus, apice integro; long. 1·75 in., lat. ·2 in. A remarkably ungraceful shell, reminding one of thick specimens of *novemcostatum*, Lam. The breadth is almost the same throughout, ribs very indistinct and impossible to count at the base, interstitial lines proportionately strong.
Cadulus gadus	Not unfrequent; 20–30 fath.		
—— *clavatus, *Gould.*			
[Ditrupa subulata, *Desh.*]..	[Four specimens.]	....	Quite undistinguishable from Mediterranean specimens.
CHITONIDÆ.			
Lophyrus affinis, *Issel* [=siculus, *Gray*].	Frequent, several varieties.	....	I am quite unable to separate this from the well-known Mediterranean species. Issel indeed (Mar Rosso, p. 235) asserts—and it is the only difference he can find—that there is a distinction in the number of ribs on the anterior plate. On examining a large number of *Ch. siculus* from various parts of the Mediterranean, I only find that what Issel thus holds to distinguish *siculus* from *affinis* serves also to distinguish *siculus* from itself, for the ribs vary ex-

Shell.	Station.	Distribution.	Remarks.
			ceedingly both in number and in strength.
Acanthopleurus spiniger, *Sow.* [piceus, *Gmel.*].	Frequent (*teste* Carp.).	Pacific and Philippine Islands. [Darnley I., Torres Straits, Port Jackson, West Indies.]	There may be points of distinction which can be advanced, but at present I cannot separate these specimens from *piceus*, Gmel., a common West-Indian shell. The girdle, in particular, in each set of shells is studded with exactly similar ivory-white tusk-like moss. *Spiniger*, Sow., seems a different species altogether.
Tonicia suezensis, *Reeve* ..	Not frequent.		
Acanthochites coarctatus, *Sow.*	One specimen.	Philippines.	
—— scutiger, *Ad. & Reeve* [discrepans, *Brown*].	Rare.	....	There are half a dozen specimens, which I cannot separate from Mediterranean specimens of *discrepans*, Brown; they correspond in the minutest particular. *Scutiger* is said by Reeve (Conch. Ic.) to be described in the 'Samarang;' but although there are two *Chitons* figured on pl. xii., no reference to them is made in the letterpress, nor is there any key to the plates.

[To be continued.]

XXVII.—*Descriptions of Sponges from the Neighbourhood of Port Phillip Heads, South Australia, continued.* By H. J. CARTER, F.R.S. &c.

[Continued from vol. xv. p. 321.]

FOR ready reference I will also here insert a tabular view of my arrangement of the order RHAPHIDONEMA, as I shall take this (probably my last) opportunity of offering such revisionary remarks on it as my experience since it was published in 1875 seems to dictate. It is as follows:—

Order IV. RHAPHIDONEMA.

Families.	Groups.
1. *Chalinida*	1. Digitata. 2. Palmata. 3. Reptata. 4. Spinifera.
2. *Cavochalinida*	5. Tubulodigitata. 6. Aculeata. 7. Subaculeata. 8. Ciliata. 9. Bivalvata. 10. Complanata. 11. Plicata.
3. *Acervochalinida*	12. Solida. 13. Clathrata. 14. Dictyalia.
4. *Pseudochalinida*	15. Digitifera. 16. Fistulodigitata.

The diagnosis which I have given for this order—viz. "Possessing a skeleton composed of horny fibre with a core of proper spicules. Form of spicule chiefly simple acerate and chiefly confined to the interior of the fibre,"—is too short and indefinite to lead the student to the more useful or distinguishing characters of that kind of sponges which the order is intended to comprise, whose typical structure, to which I shall hereafter more particularly allude, may be taken from that of *Chalina polychotoma*, Esper. What this type is we learn from Johnston, who, with a specimen of the British species before him, identified it with Esper's "*Spongia polychotoma*, tab. xxxvi." (Johnston, Hist. Brit. Sponges, &c. p. 94, pl. iii.).

The name given by Johnston to this sponge is "*Halichondria oculata*," which Dr. Bowerbank changed to "*Chalina oculata*" (Mon. Brit. Spongiadæ, vol. ii. p. 361), accompanied

by the statement that Dr. Grant, in his 'Tabular View of the Animal Kingdom' (1861, p. 76), had established the genus "*Chalina*" for sponges possessing the structure of Johnston's *Halichondria oculata* (Mon. vol. i. p. 209); so this is how we came by the term "*Chalina*."

But Johnston had previously identified his *foregoing* species, viz. *Halichondria palmata* (*op. cit.* p. 92, pl. ii. fig. 1), with Esper's *Spongia oculata*, "tab. i.," and also with Ellis's *Spongia palmata* (Ellis & Solander, p. 189, pl. lviii. fig. 6). Now all three of their illustrations represent the oscules as projecting (pustuliform) and scattered over the frond; while in Grant's illustration of *Spongia oculata* (Edinb. New Phil. Journ. 1826, vol. ii. p. 140, pl. ii. fig. 22), as well as in Johnston's *Halichondria oculata*, they are, as Johnston stated, "mostly disposed along the margin," that is on opposite sides of the cylindrical branch (*op. cit.* p. 95), which was probably the case in Esper's *Spongia polychotoma* (tab. xxxvi.), as they are not represented on the *surface* of the branches of his illustration. Hence it is evident that Esper's *Spongia oculata*, so far as appearance goes, is Johnston's *Halichondria palmata*.

But the latter is also stated by Johnston to be the "Mermaid's Glove" of the Shetlanders, which Bowerbank calls "*Isodictya palmata*" (Mon. vol. ii. p. 311, and vol. iii. pl. lii.), adding very properly to the simple skeletal acerate of this sponge in his illustration an equianchorate, which, on microscopic examination, I find to be so *peculiar* in shape, that the "flesh-spicule" in this instance becomes a distinguishing character, whereby I have been enabled to identify it with Johnston's *type* specimen of his *Halichondria palmata* in the British Museum *. Hence also Esper's *Spongia oculata* and Ellis's *Spongia palmata*, if they possessed this distinguishing character, become Dr. Bowerbank's "*Isodictya palmata*."

Be this as it may, however, the structure and skeletal spicule of Johnston's type specimen of *Halichondria palmata* are so like those of *Chalina polychotoma* that I have not hesitated, in opposition to Dr. Bowerbank's view, to change his generic term "*Halichondria*" to *Chalina palmata*, as may be seen by my description and illustration of the latter in the 'Annals' of 1882 (vol. x. p. 109, woodcut, fig. 1), where I have fully gone into the subject, therefore need not repeat any more of it here.

Why Johnston should have designated his sponge "*oculata*" after having identified it with Esper's "*polychotoma*" I am

* Schmidt's only instance of this is in the *in*equianchorate of his *Esperia sentinella* (Spong. Küste v. Algier, p. 30, Taf. v. fig. 11).

unable to conceive, unless he considered that both were only variations of the same sponge, which I think very likely, especially as the form of "*polychotoma*" very often runs into that of "*oculata*;" and Johnston himself, as before noticed, has placed them together, that is one after the other, in his 'British Sponges.' But then neither "*oculata*" nor "*polychotoma*" possesses a flesh-spicule, which *Chalina palmata* does, and Johnston did *not* know this; so something else must have influenced him in using this designation, probably the designation "*palmata*," which Ellis used for the sponge that Johnston considered to be his "*Halichondria palmata*;" still, as before stated, unless it could be proved that Ellis's sponge contained the *peculiarly* formed anchorate to which I have alluded, it is quite as likely, as just stated, that his sponge was a mere variety in form of *Chalina polychotoma*.

So much for confusion in nomenclature when names are based on mere resemblances; but it should be remembered that all this took place before the achromatic microscope had been invented, after which distinctions on minute differences which then came into view were rendered comparatively easy. We know, however, now that Johnston's *Halichondria palmata* differs in possessing the peculiarly-formed anchorate, to which I have above alluded, from all the other Chalinida, and that the species is identical with the "Mermaid's Glove."

The chief distinguishing characters of the order Rhaphidonema, in addition to the diagnosis above mentioned, are their easily yielding to pressure and corresponding resiliency, from the keratose element of the fibre predominating, the spicular element more or less scanty, the structure loose, and, as Ellis noticed in 1786 (*op. cit.* p. 185), "the gelatinous part of the flesh [the sarcode] is so tender that when it is taken out of the water it soon dries away." In structure the deeper part is generally less dense than the circumference, which is also generally the opposite in the following order, viz. the Echinonema; hence the former are for the most part easily compressible, while the latter are generally much less so, and often even absolutely hard. In spiculation there is generally only one form of spicule, and that is the simple or commonest form of acerate, viz. smooth, curved, fusiform, and sharp at both ends; while in the Echinonema there is generally *more* than one form, of which one is generally acuate, that is an acerate with one end obtuse. In the Rhaphidonema the skeletal is seldom accompanied by a flesh-spicule, while in the Echinonema it is seldom without one. The spicule in the Rhaphidonema is generally confined to the fibre, hence its

comparatively smooth surface; while in the ECHINONEMA, as the name indicates, more or less of the pointed end always extends beyond it, echinatingly or in tufts. The oscules or vents are conspicuous in the RHAPHIDONEMA, while in the ECHINONEMA they are generally inconspicuous, from the excretory systems in the latter being generally smaller and thus more numerous, in accordance with their greater density of structure.

Thus I have contrasted the RHAPHIDONEMA with the ECHINONEMA because in many instances their forms otherwise are so much alike; but the structural characters of the RHAPHIDONEMA run throughout the order so uninterruptedly that, different as the forms may be (which have chiefly led to the grouping), they will be found to be so constant that, although the order contains a number of species, they may easily be found out under the arrangement I have made, which, for the same reason, requires very little revisionary remark.

When I inserted the group "Palmata," which is the second on the list, I had not seen Bowerbank's specimen of the "Mermaid's Glove," now in the British Museum, nor had I identified it with Johnston's type specimen of *Halichondria palmata* there, by finding that the latter possessed the same peculiar form of anchorate; so for the present this group can be considered to be represented by only one species, viz. *Chalina palmata.*

There are three other forms, in all of which the skeletal acerate is accompanied by the same kind of equianchorate flesh-spicule; but this is of the common navicular shape, and all come from the neighbourhood of the Cape of Good Hope, as will be more particularly noticed hereafter.

Of the groups in the third family, viz. the Acervochalinida, I can state nothing decisive, excepting that there *are* solid forms of RHAPHIDONEMA, but their massive condition, aided only by the characters afforded by their structure and spiculation, so far have not enabled me to identify one in particular; while the "footnote" to the group "Dictyalia" in my classification (*op. et loc. cit.* p. 143), whose purport is as follows, adds still more to the difficulties, viz.:—"In some instances the predominance of the keratine element in the RHAPHIDONEMA is exchanged for the predominance of the spicular one in the order HOLORHAPHIDOTA, when the same species must be placed in one or the other, as the case may be, while the group 'Isodictyosa' in the latter chiefly offers the species with which those of the RHAPHIDONEMA are most likely to be confounded." But such difficulties are inseparable from a classification made by man to aid his memory, and which nature ignores!

Thus, while the facts may be still fresh in the memory of those who have read my report on the collection of marine sponges from Japan &c. ('Annals,' 1885, vol. xv. p. 387), it might be observed that the polychotomous *Chalina* there referred to (p. 402), although possessing the same form of spicule as a similar species from the Mauritius, is a *bonâ fide* solid, branched, and stipitate Chalinoid form characteristic of my group "Digitata," while that from the Mauritius is an Isodictyal Chalinoid form, in which the skeletal spicule is not only larger, *but accompanied by a minute acerate flesh-spicule.* Hence, while the latter retains the proposed designation, viz. "*mauritiana,*" the former, for distinction's sake, might be designated "*japonica.*" (This, however, must be considered as an *ex post facto* statement, since I was not made aware of the presence of the flesh-spicule until after I had first written the passages to which I have referred.)

Now the Mauritius specimen (that Mr. B. W. Priest kindly submitted for my examination, which, with a true *Chalina*-like form, consisted only of a fragment about 3 inches long and half an inch in diameter), presents on one side a flat surface by which it had adhered to a mass of *Nullipore* on which it had been growing; and thus the specimen bears the same relation in this respect to a solid, digitate, erect *Chalina* of the British seas, that is *C. polychotoma*, that the latter does to our British *Halichondria simulans*, Johnston (pl. viii.), = *Isodictya simulans*, Bk. (Mon. vol. iii. pl. li. figs. 5 and 6), which, although occasionally rising up more or less into a *Chalina*-like branched stem, as frequently creeps in this form over the surface of the rocks on which it may be growing (see Johnston's illustrations, *l. c.*); but in the Mauritius specimen, as before stated, the skeletal is accompanied by a flesh-spicule. In short the spiculation of the Mauritius specimen consists of a large sausage-like form with several smaller ones in various stages of development chiefly about the angles of its reticulated structure; and a minute, sharp-pointed, fusiform, acerate flesh-spicule, chiefly arranged like a row of swallows on a telegraph-wire, along the course of the large spicule or spicular reticulation; while also, as before stated, the Japan specimen only presents *one* form, viz. the sausage-shaped one, which is much smaller, as may be seen by my illustrations ('Annals,' *l. c.* pl. xiv. figs. 12 and 13).

Again, in Dr. Bowerbank's representations of his *Chalina oculata* (Mon. vol. iii. pl. lxvi.) and that of his "*Isodictya varians*" (*ib.* pl. lxxxviii.), the former from a specimen from the open sea in the English Channel off Hastings, and the latter from one from the mouth or estuary of the Mersey at

Liverpool, close to the entrance of a *freshwater* tributary, the only difference that I can see, for I have specimens of both in my possession, amounts to the simple modification that arises from a predominance of keratine, whereby the open-sea specimen is tougher and more resilient than the estuary one, which, being the reverse, is softer and more fragile, the spicules being much the same in size and shape in both.

How far the general form and the sausage-shaped spicule of the freshwater sponge *Uruguaya corallioides*, Bk., which equally agrees in these respects with both *Chalina japonica* and *Chalina mauritiana*, may favour the view of those who would refer *Uruguaya* to a marine origin, I am not able to say; or to come to the conclusion of Dr. W. Dybowski that, because *Lubomirskia baicalensis*, viz. the solid, caulescent, branched, chaliniform freshwater sponge of Lake Baikal, in Central Asia, is identical in general structure and in the form and nature of its spicule with a similar but *marine* one which his brother sent him from the shores of Behring's Island, in the Kamtschatka Sea,—the former is necessarily the latter living in fresh water ("Die Behringsschwämme weichen weder in ihrer Struktur noch in der Gestalt und Beschaffenheit der Spiculen von denen der Baikalschen Exemplare ab, so dass alle diese, obgleich aus so sehr verschiedenen Fundorten herkommenden Schwämme, als vollkommen identisch anzusehen sind," Sitzungsbericht d. Dorpater Naturforscher-Gesellschaft, Jahrg. 1884, p. 45), although geologically considered it is as easy to infer that the sea, when receding from the interior of continents, might have left saltwater lakes there, which have become as fresh as the marine formations beside them, in which there is now not a particle of salt left. But as yet, if neither *Uruguaya* nor *Lubomirskia baicalensis* has been found to possess statoblasts, so neither have they been found in an ovigerous condition—conditions, especially of the latter, which can *only* be maintained for home-demonstration by being at once preserved in some aqueous medium, such as spirit and water; *i. e.* on the spot.

I have entered more at length into this subject here than I had an opportunity of doing in my report on the Japan sponges, chiefly because the Mauritius sponge is, according to my view, a *Chalina* (*C. mauritiana*), and its spiculation so peculiar that it is deserving of special mention.

Lastly, for my observations on the fourth or concluding family of the order RHAPHIDONEMA, viz. the Pseudochalinida, I must refer the reader to the species described in the 'Annals' of 1882 (vol. ix. p. 280), and 1885 (vol. xv. p. 319).

Returning to the first family, viz. the Chalinida, it might be observed that this was, as before noticed, the name given by Dr. Grant to the third order of his PORIFERA (Tab. View An. Kingdom, 1861, p. 76, Walton and Maberly) for the purpose of including sponges "possessing the structure of Johnston's *Halichondria oculata*," which is our *Chalina polychotoma* = *Spongia polychotoma*, Esper, = *Chalina oculata*, Bk.; and it may also be observed in the "Key to my Classification of the Spongida" (*Op. et loc. cit.* p. 193) that I have given this as the *type* of group No. 1, viz. the "Digitata," whose "typical structure," to which I have before alluded only in a general way, may be more particularly stated as follows:—"A stipitate bunch of caulescent cylindrical stalks, more or less ramosely dividing dichotomously and polychotomously, more or less interuniting on their way to their termination in rounded ends. Easily yielding to pressure, but still very resilient. Colour, when dry, light sponge-yellow, often retaining traces of purple, which appears to be its original colour, at all events in many instances. Surface uniformly smooth, which is not the case in the ECHINONEMA. Vents chiefly in single lines, opposite to each other, on each side of the cylindrical stalk. Structure internally open, where the sarcode, which is very thin (as Ellis noticed), has disappeared, as is usually the case in dried specimens; more compact towards the surface, where the dermal structure is finer and closer than that which is below it. Fibre predominantly keratose; spicule acerate, curved, fusiform, smooth, sharp-pointed, variable in size, which is chiefly small, often minute. General form also variable."

As regards the latter character, viz. the variability in form, I cannot do better than refer the reader to Miklucho-Maclay's paper (Mém. de l'Acad. de St. Pétersb. vii. s. t. xv. no. 3, 1870) on the varieties of his "*Veluspa polymorpha*," which is an estuary specimen of *Chalina polymorpha*, as may be seen by reference to the typical form (Taf. i. fig. 1), among which the Baikal freshwater sponge *Lubomirskia baikalensis*, Pallas, is introduced as No. 11 (Taf. i. fig. 5).

This brings us to the consideration of the specimens of RHAPHIDONEMA in Mr. Wilson's collection from the neighbourhood of Port Phillip Heads, Victoria Col., S. Australia, which, although very numerous, belong to only three groups: viz. the Digitata, the Tubulodigitata, and the Bivalvata respectively, but mostly to the first, under which *Chalina polychotoma* and its varieties will presently be mentioned, followed by a single species of Tubulodigitata and the same of

Bivalvata. In all the spicule is of the same form, viz. acerate, smooth, curved, fusiform, and sharp-pointed, but for the most part very small and often minute, *i. e.* not exceeding 7-6000ths in. in length, with almost immeasurable thinness, combined with great thickness of keratine in the fibre, which, as before stated, leads to great toughness and resiliency. In my British specimens of *Chalina polychotoma*, obtained from the English Channel opposite this place (Budleigh-Salterton), the spicule is about 30 by $2\frac{1}{4}$-6000ths inch in its greatest dimensions.

Fam. 1. **Chalinida.**

" *Char.* Digitations solid, vertical or procumbent."

Group 1. DIGITATA.

Chalina polychotoma, Esper.

Of this species in Mr. Wilson's collection there are several specimens, whose characters having already been mentioned, need not be repeated here. Largest specimen 2 feet long. Depth not mentioned. Neither the colour when fresh nor the depth of the dried specimens is stated.

Chalina polychotoma, var. *trichotoma*.

Described in the 'Annals' for 1885 (vol. xv. p. 115). This variety only differs from the foregoing in most of the ends of the branches being more or less expanded and trichotomously divided. 19 inches long. Presented to the British Museum in the name of J. Bracebridge Wilson, Esq., M.A., F.L.S. Dried specimen.

Chalina polychotoma, var. *compressa*.

Where the stem becomes more or less expanded and compressed at the commencement of the branches, or where the latter becomes expanded towards their ends spatuliform (*spatulata*). Vents scattered over the expanded portions, chiefly on one side, comparatively small and not projected. Two wet specimens:—viz. 1, wholly compressed; colour, when fresh, "purple-slate;" $5\frac{1}{2}$ in. long. 2, subcompressed; colour, when fresh, "pale buff-brown;" 13 in. long. Depth of both 19 fath.

Chalina polychotoma, var. *oculata*.

Stems thick, more or less irregular in form, *i. e.* more or less irregularly expanded and united together in their whole length, flabelliform, proliferous. Colour dark-brown reddish.

Surface smooth. Vents large, circular, projected pustuliformly, scattered over the surface generally, or, where the branch is expanded, chiefly on one side.

Obs. Here I should be inclined to place Esper's *Spongia oculata* (tab. i.) and Ellis's *Spongia palmata* (tab. lviii. fig. 6), if, as before stated, they were not possessed of the peculiar anchorate of *Chalina palmata*, Johnston.

Chalina polychotoma, var. *robusta.*

In which the stems are few, thick, and large, with smallish vents on one side chiefly. Wet specimen. Colour, when fresh, "orange-buff." 11 in. long.

Depth 20 fath.

Chalina polychotoma, var. *angulata.*

Stem nodosely angulated, zigzag instead of being uniformly cylindrical; presenting a knotted appearance, in which the nodose portion may be slightly prolonged branch-like on each side, so as to give the stem an alternately jointed zigzag aspect. Colour dark black-brown on the surface, light brown interiorly, or light brown throughout. Surface soft, velvety from the fineness and compactness of the dermal tissue. Vents of two sizes, large and small, scattered over the nodose portions irregularly. Fibre and structure finer and more compact than in *C. polychotoma*, accompanied by more remains of the sarcode. Size of largest specimen, which is wet, 15 in. long. Colour, when fresh, not given.

Depth 19 fath.

Chalina polychotoma, var. *moniliformis.*

Stems successively inflated more or less regularly. Colour light brown. Surface velvety. Vents scattered over the bullate inflations. Texture, *i. e.* the fibre and structure, as in the foregoing variety, viz. "*angulata.*"

Obs. This comes in as a sequence of very common occurrence, but not represented in Mr. Wilson's collection, although there are several large specimens in the British Museum which come from the south coast of Australia.

I have briefly enumerated these varieties in form, not only because they are chiefly present in Mr. Wilson's collection, but still more because they are of general occurrence: that is, the stalks, originally smooth and cylindrical in the typical form, viz. *Chalina polychotoma*, may become partially flattened; then expanded and more or less united laterally either at the com-

mencement or at the extremities; then expanded and united generally into a flabellate more or less proliferous plane; lastly, jagged or irregularly moniliform; while the vents may be comparatively small and linearly arranged opposite to each other on the cylindrical branch in the typical species, scattered in the compressed forms, and projected pustuliformly in the oculate specimens. The colour may vary from light sponge-yellow to dark sponge-brown, more or less mixed with red, and often to reddish purple; but, of course, this is useless for specific distinction.

Fam. 3. **Cavochalinida.**

"Tubular, vasiform, aculeated, patulous or compressed flabellately; plane and frondose or dactyloid."

Group 3. Tubulodigitata.

Patuloscula procumbens, Carter ('Annals,' 1882, vol. ix. p. 365).

Short, thick, thumb-shaped, cylindrical, bullate, hollow, erect processes, growing side by side on a common expanded base, spreading in a branched form horizontally. Consistence resilient. Colour, when fresh, "purple-slate," now sponge-yellow brown. Vent terminal, cloacal, circular at the end of the process, contracted, but still enormously large. Spicule acerate, as before. Size of specimens, of which there are two, varying from 2 to 6 in. high, and 6 × 4 horizontally.

Depth 7 to 14 fath.

Obs. This is also a West-Indian sponge and appears to have been noticed and illustrated by De Fonbressin and Michelotti under the name of "*Callyspongia bullata*" ('Spongiaires de la mer Caraïbe,' Harlem, 1864, p. 56, pl. x. fig. 5). I have already given the name to some beautiful specimens of it, brought home from the West Indies by the Rev. H. H. Higgins, now in the Liverpool Museum, in one of which the bullate processes, successively inflated, are extended upwards separately for 3 or 4 inches. A specimen of these was also presented to the British Museum in the month of March 1877. It is not the *Spongia bullata* of Lamarck = *Sp. tubulosa*, Esper, tab. 54, since the vents here are *ciliated*, as D. et M. have noticed, which allies it to their genus "*Tuba*," that is typical of our groups Aculeata &c. (see my "Classification," *l. c.* "Key," p. 194; and for the genus "*Tuba*," generally, 'Annals,' 1882, vol. ix. p. 277 *et seq.*, West Indian and Acapulco sponges).

Patuloscula procumbens, var. *flabelliformis*.

In this variety the successively dilated bullate tubes or

processes, which are very long comparatively, are united laterally throughout into a fan-shaped form, rising from a single stem, the large circular vents being arranged serially on the margin. Largest specimen about 8 in. high by 8 × 1 in. horizontally. Colour, when fresh, "buff-grey."

Depth 20 fath.

Group 9. Bivalvata.

Cavochalina bilamellata, Lam.

Stipitate, placentiform, doubled up like a bivalved shell with a stem, *i. e.* vasiform compressed; infundibular below as the head approaches the stem, which is long and hard, ending in a root-like expansion, expanding, in the contrary direction, into a flabelliform bilamellar head above. Consistence leathery. Colour, when fresh, "pale pinkish brown," now mouse-brown. Surface externally wrinkled, rugosely reticulated in high relief, nodose; inside even, smooth, concentrically lineated. Vents small, scattered over the inner surface. Structure compact, fine, composed of short-jointed keratose fibre, scantily charged with the usual form of small spicule, viz. acerate, smooth, curved, fusiform, sharp-pointed, about 14 by $\frac{2}{3}$-6000ths in. in its greatest dimensions. Size very variable, apparently increasing with the age of the specimen; the largest, of which there are several dry, but only one wet specimen, about a foot each way, including the stem, which may be 3 or 4 in. long, with a thickness of the head towards the stem about one inch where the nodular excrescences are most prominent, becoming gradually thinner in the opposite direction, that is towards the border, where the nodular processes ceasing leave a narrow smooth strip about one sixth of an inch in thickness.

Depth 19 fath.

Hab. Marine.

Loc. Port Phillip Heads, south coast of Australia.

Obs. This seems to me to be the species briefly described by Lamarck (1st ed. t. ii. p. 366, no. 61), so I have given it his designation. There are several dry specimens in Mr. Wilson's collection, but only one wet one. From the great number which I have seen it must be very plentiful under all forms on the south coast of Australia, but all modifications of that above mentioned; whilst its leathery imperishable nature and great toughness arising from the quantity of keratine in the composition of its fibre, scanty and small spiculation, and compact structure, render it as durable almost as the sole of a shoe. It is subject to considerable variety in form, being

sometimes expanded horizontally and proliferously foliated or cabbage-like.

Group 11. Plicata.

Although not in Mr. Wilson's collection, but coming from hard by, viz. the neighbourhood of the Cape of Good Hope, and therefore probably represented on the south coast of Australia, I would here insert the following description of the specimen, which is intended to typically illustrate the species for which this group was instituted, as although promised in my Classification, it has not hitherto been given.

Textiliforma foliata.

Large mass of cloth-like, flat, very thin and expanded frondose portions, rising from a contracted short stem, apparently independent of each other, but, in fact, all continuous, although so interfolded and deeply indented at the margin as to present a plurality of separate dissepiments; or, in a large, single, semicircular, stipitate, frondose form, more or less proliferous. Consistence firm, resilient. Colour, now in its dried state, pale yellow-brown, with traces of the original sarcode, which was purple. Surface uniformly even on both sides. Vents, in little groups, petaloid, rosette-like, scattered plentifully over the surface; each group about 1-24th in. in diameter and 1-12th in. apart; but while confined to one surface only this depends upon the position of the fold, so that on one part they may be on one side and on the other on the other; hence they are in patches, that is not continuous throughout the same side of the frond, in the interfolded or plicate form; while, of course, in the other form, where there is no plication, they are all on one side. Internal structure compact, tough, formed of short-jointed keratose fibre charged with the usual form of acerate spicule internally, and surrounded by sarcode equally charged with the same spicule together with a number of equianchorates or flesh-spicules. Skeletal spicule curved, smooth, fusiform, sharp-pointed, about 28- by $2\frac{1}{2}$-6000ths in. in its greatest dimensions. Flesh-spicule, a navicular shaped equianchorate with rather obtuse ends when viewed in front, about 6-6000ths in. long. Size of largest specimen 17 in. high by 12 in. broad; wall of the frond or lamina $\frac{1}{8}$ in. thick.

Hab. Marine.

Loc. Cape of Good Hope and its neighbourhood.

Obs. There are several specimens of this sponge in the British Museum (all dry, of course), viz. No. 60, registered 71. 5. 12. 1, &c. from Port Elizabeth; and No. 509, registered 40. 9. 28. 27, from "the Cape;" together with two other

forms from "the Cape," presenting a similar structure and spiculation, viz. *Chalina compressa*, which has already been described in the 'Annals' of 1882 (vol. x. p. 112), and might be relegated to the group "Palmata" for the present, as representing the "Mermaid's glove" at the Cape; and a third, which from its form might be relegated to the "Digitata" and termed "*Chalina polychotoma*, var. *anchorata*," as its skeletal acerate is also accompanied by an equianchorate flesh-spicule; but in the two latter the navicular anchorate is pointed at the ends instead of being round or obtuse; although in all three instances belonging to that kind which from its boat- or shuttle-like shape I have termed navicular.

These are the specimens from the "neighbourhood of the Cape of Good Hope" to which I have alluded, at p. 280, as possessing the same kind of naviculiform anchorate.

Ovigerous Specimens.

In the ovigerous specimens, of which there are a great many in Mr. Wilson's collection, not only of the RHAPHIDONEMA, but of all the other orders, the form and position of the ova remain; but the same astringent effect of the spirit which has kept them thus has contracted their *contents* into a cheesy consistence which defies all attempt at further elucidation. In short, to do anything with the soft parts of a sponge in the microscopical or more *minute* way it is absolutely necessary to examine them immediately after they have been taken from their native habitats, that is while they are living. Much may be done by putting them into spirit and water at once and examining them a few days after they have been thus preserved; but the longer they remain after this the more these parts become chemically altered by the methylated spirit and rendered unfit for anything but a display of the larger parts of which they are composed, from the change especially in the contents of the ova and the sperm-cells, to which I have above alluded; and the development of calcareous crystallizations in the general tissue.

Order V. ECHINONEMA.

For the reasons above mentioned I shall also insert here a tabular view of my arrangement of this order in 1875 (*op. et loc. cit.*), viz.:—

Families.	Groups.
1. *Ectyonida*	1. Pluriformia. 2. Plumohalichondrina. 3. Microcionina. 4. Echinoclathrata. 5. Baculifera.
2. *Axinellida*	6. Multiformia. 7. Durissima.

And here I would observe that this order is by far the most difficult of any that I have had to contend with; not so much probably in the first family, viz. the Ectyonida, as in the second, viz. the Axinellida; hence in both they are headed with a group *provisionally* named, which has thus been indefinitely given for the purpose of enabling the spongiologist to supply its place with a plurality of groups that of course must vary in amount, name, and description as more extended observation may dictate, which, judging from the enormous number of species and varieties from all parts of the world, represented by the dried and beach-specimens in the collection of the British Museum, almost tempts one to exclaim, " Where is this to end ? " and as one species so often resembles another in one or more points, to ask " What character is there in one species which is not to be found in another ? " But probably similar observations were made at the commencement of the study of conchology&c.; still it seems to me certain that, as in other branches of natural history, the class, orders, and families may be restricted to a few simple characters for leading to the groups and genera, but *nothing but a combination of characters* will lead the student to the *species*, which is the great thing after all, and those it is desirable, for practical purposes, to limit as much as possible to what can be seen with the commonest microscope, otherwise the distinctions become one for the rich man only who has plenty of leisure and can easily afford to purchase a fine instrument; which, of course, is also desirable; but then this cannot be for the many, but for the scientific, or, as it may be termed, *esoteric* few. Hence " equality " is as utopian, as *in*equality is absolutely necessary for progress in all human affairs. Such knowledge can only come to the poor *through* the rich.

The diagnosis of the order ECHINONEMA, viz.:—" Possessing a skeleton composed of horny fibre cored with proper spicules internally and echinated with proper spicules externally. Form of spicules chiefly acuate," so far as the first family, viz. the Ectyonida, goes, cannot be more practically

useful, for I know of no exception to it. But it does not apply so satisfactorily to the second family, viz. the Axinellida; neither does the special diagnosis of *this* family, viz.:—"Echinated with proper spicules projecting from the *interior* of the fibre," suffice for all, since it may be the case to a certain extent with species of the RHAPHIDONEMA; but by adding the words:—"Structure increasing in density *inwards* or towards the first-formed parts, that is the axis," which for the most part is a *peculiarity* common to the whole order, although not needed in the diagnosis of the first family, that of the second family is rendered almost equally useful.

It will be observed by referring to the above "table" that each of the families commences with a "group," whose name etymologically has the same signification, viz. "Pluriformia" and "Multiformia," which, as before stated, were *provisionally* instituted, because the specimens which appeared to belong to them respectively were at the time of classification so numerous as to be quite overwhelming; therefore all that I could do under the circumstances, that is with little or no literature for my guidance, was to keep them together, as I have before observed of the Psammonemata, under the families mentioned, for subsequent division into groups when their species, by individual description from undried and entire specimens, should be typically determined. It was this to which my dear old friend Dr. J. E. Gray alluded when he said:—"The greatest contributor to our knowledge and advancement of spongiology in its present state will be he who correctly describes and illustrates most species."

Fam. 1. **Ectyonida.**

Group 1. PLURIFORMIA.

In the "key" to my classification (*l. c.* p. 195) I have given the names of several kinds of sponges which I then thought might become types of the subdivisions of this group, and during the last ten years which have elapsed since that was published I have occasionally been able to substantiate it thus:—"*Ectyon sparsus*" has led to the formation of the group "Ectyonina" or "Ectyones" ('Annals,' 1883, vol. xii. p. 310, &c.); "*Echinonema typicum*" to one for which I would propose the name of "Echinonematina" (*ib.* 1881, vol. vii. p. 378, &c.); "*Dictyocylindrus ramosus*, Bk.," &c. to that of "Dictyocylindrina" (*ib.* 1879, vol. iii. p. 295); and "*Spongia muricata*, Pallas, = *Trikentrion muricatum*, Ehlers,"

to that of the group "Trichentrionina" (*ib.* 1879, vol. iii. p. 293, &c.).

Groups 2, 3, and 4 of the Ectyonida, viz. Plumohalichondrina, Microcionina, and Echinoclathrata, I must leave as they are, merely observing that "*Halichondria seriata*," Johnston, = *Ophlitospongia* (olim *Chalina*) *seriata*, Bk., unfortunately does not illustrate the group *etymologically*, on account of being solid instead of clathrate; but then it was, as it is now, the only species of the group that had been publicly described, so that I had no option, but will now endeavour to supply this apparent discrepancy by adding the description of a dried foreign species, equally remarkable for its clathrate character, which is solidly *cellular* throughout rather than *simply* solid, and thus resembles the nidamental mass of a whelk or a bee's honeycomb rather than a sponge:—

Echinoclathria favus, n. sp.

Massive, lobed, sessile or contracted towards the base, or divided digitately from this upwards into a bunch of coalescent cylindrical stems, dichotomously and polychotomously branched, like a digitate *Chalina*. Consistence now in its dried state soft and resilient. Colour reddish brown or yellowish. Surface even. Structure composed of a thin fibro-reticulate lamina, continuous in itself, but partitionally separating vermicular cavities, which are equally continuous throughout, thus producing a uniformly clathrous mass which, on the surface, presents a honeycomb appearance, in which the cells, which are irregular in outline, are about 3-12ths in. in diameter more or less. Fibre both cored and echinated with proper spicules. Core- or skeletal spicule very thin, subpin-like, smooth, fusiform, constricted towards the head, about 45-6000ths in. long. Echinating spicule smooth, also subpin-like, fusiform, and constricted towards the head, which is less in diameter than the shaft, about 15 by $1\frac{1}{2}$-6000ths in. in its greatest dimensions. Size of specimens variable.

Hab. Marine.

Loc. South coast of Australia.

Obs. This sponge is so striking in its honeycomb algoid appearance and soft though resilient consistence that it can hardly be mistaken for any other excepting the *areniferous* variety of the same sponge, which will be described hereafter in the new family which I propose to call "Pseudoechinonemida."

There are several specimens of it in the British Museum, mostly under 4 inches in their greatest diameter, of which nos. 554 and 555, each registered 59. 10. 7. 106, may be

mentioned as massive forms, and no. "208 *bis*," registered 37. 5. 13. 36 &c., as more or less digitate forms somewhat like those of *Chalina polychotoma*; so that it appears to be by no means common, although it is so remarkable in structure.

Again, in group 5, viz. the Baculifera, the echinating spicule is not spined, but its hammer-shaped or crutch-like head is imbedded in the surface of the fibre, together with a like form in its interior, which, combined with its cork-like consistence, unmistakably defines this type.

HIGGINSINA, new group.

Lastly, to this family I must add the group above mentioned, viz. "Higginsina," for sponges in which the apparent analogue of the spined echinating spicule is not club-shaped, but acerate, that is fusiform and sharp-pointed, and *not* echinating, but *loose* in the tissue; for a typical species of which I must refer the reader to the West-Indian sponge "*Higginsia coralloides*" and its varieties described and illustrated by Mr. Thomas H. Higgin, F.L.S., in the 'Annals' for 1877 (vol. xix. p. 291 &c. pl. xiv. figs. 1–5). Called after the Rev. H. H. Higgins.

To this I will add the following description of a Cape variety of this sponge, in which the *un*attached position of the echinating spicule is not so evident, and an *acuate* is added to the acerate skeletal spicule.

Higginsia coralloides, var. *natalensis*, n. var.

Flabelliform, erect, stipitate, ridged on each side proliferously; ridges thin, ragged, and in strong relief, radiating and branching from the stem to the circumference. Consistence tough, firm, in the dry state, with hard inspissated sarcode and compact structure. Colour orange. Surface uneven, hispid. Spicules of three forms, viz.:—1, skeletal, thick, smooth acuate, 70 by 3-1800ths in. in its greatest dimensions; 2, subskeletal, thin, smooth acerate, about 50 by $\frac{1}{2}$-1800ths in.; 3, echinating spicule, a spinous acerate rather bent than curved in the centre, about 8 by $\frac{1}{2}$-1800th; no. 1 is arranged in tufts surrounded by no. 2 in great numbers, among which is no. 3, all projecting outwardly, as they successively and together emanate from the fibre. Size variable, the largest specimen $5\frac{1}{2}$ in. broad by $2\frac{1}{2}$ in. high.

Hab. Marine.

Loc. Port Elizabeth, Cape of Good Hope.

Obs. Of this species, whose spiculation is somewhat diffe-

rent, although evidently belonging to the genus *Higginsia* in other respects, there are several dry specimens in the British Museum, of which No. 18 is the largest. No. 40 is an elkhorn-shaped, rat-tailed, flat, branched variety, and Nos. 16, 17, and 19, all more or less like that above described, and all registered 71. 5. 12. 1 &c.

Gen. obs. In many of the Ectyonida there are flesh-spicules, viz. equianchorates, bihamates, or tricurvates, and these may be alone or combined. The anchorate is generally of that kind termed navicular from its boat-like form, *i. e.* sharp at each end; the bihamate a small simple C- or S-shaped one; and the tricurvate also small and simple. In one instance, however, the anchorate is "angulate," that is, the shaft is bow-shaped and turned up at the ends (see Bowerbank's illustration, Mon. Brit. Spong. vol. i. pl. vi. fig. 143), characterizing the Plumohalichondrina; but in the rest the flesh-spicules do not seem to be of much specific value, on account of the sameness of their form. One more observation I would add here, viz. that the curve of the acuate skeletal spicule in the ECHINONEMA is so generally on one side the middle, and towards the obtuse end, that when I see this I feel almost confident that the sponge from which it came belongs to this order.

[To be continued.]

XXVIII.—*Remarks on a Paper by Prof. E. D. Cope on the Reptiles of the Province Rio Grande do Sul, Brazil.* By G. A. BOULENGER.

PROF. COPE'S "Twelfth Contribution to the Herpetology of Tropical America"*, contains a list of Reptiles and Batrachians from the Province Rio Grande do Sul, collected by the "Naturalist Brazilian Exploring Expedition." Having lately been engaged in naming large series of specimens from the same country, transmitted to the Natural-History Museum by the zealous Dr. H. von Ihering, and which have afforded material for several contributions published in these 'Annals' †, I am able to present a few critical remarks on Prof. Cope's identifications and new species. Besides, the nomenclature adopted by the American herpetologist differs in so many

* Proc. Amer. Phil. Soc. xxii. pp. 167–194; April 1885.
† March, April, and August numbers, 1885.

points from that followed by me, that it will be useful to place side by side the names used by us. The following is the list of the species as enumerated by Cope, with the names used in my previous "Lists." Species not contained in my Lists are preceded by an asterisk.

REPTILIA.

Lacertilia.

Cope.		Boulenger.
1. Anops Kingii, *Bell.*	=	Anops Kingii.
2. Amphisbæna trachura, *Cope*, sp. n.	=	Amphisbæna Darwinii.
3. Aporarchus prunicolor, *Cope*, g. and sp. n.	=	Amphisbæna Darwinii.
4. Pantodactylus bivittatus, *Cope.*	=	Pantodactylus Schreibersii, *Wiegm.*
5. Acrantus viridis, *Merr.*	=	Teius teyou, *Daud.*
6. Tejus teguexin, *L.*	=	Tupinambis teguixin.
7. Opheodes striatus, *Wagl.*	=	Ophiodes striatus.

Ophidia.

8. Phalotris melanopleurus, *Cope*, sp. n.	=	Elapomorphus lemniscatus, *D. & B.*
9. Opheomorphus dorsalis, *Ptrs.*	=	Liophis Jaegeri, *Gthr.*
10. —— fuscus, *Cope*, sp. n.	=	—— cobella, *L.*
11. —— meleagris, *Shaw.*	=	—— Merremii, *Wied.*
12. Aporophis conirostris, *Gthr.*	=	—— almadensis, *Wagl.*
13. —— cyanopleurus, *Cope*, sp. n.	=	Dromicus melanostigma, *Wagl.*
*14. Tachymenis hypoconia, *Cope.*		
15. Thamnodynastes Nattereri, *Mik.*	=	Thamnodynastes Nattereri.
*16. Drymobius pantherinus, *Merr.*		
17. Herpetodryas carinatus, *L.*	=	Herpetodryas carinatus.
18. Philodryas Schottii, *Fitz.*	=	Philodryas Schottii.
*19. —— Olfersii, *Fitz.*		
20. Tropidodryas æstivus, *D. & B.*	=	—— æstivus.
*21. Leptognathus Catesbyi, *D. & B.*		
22. Oxyrhopus rhombifer, *D. & B.*	=	Oxyrhopus petalarius, *L.*
*23. —— plumbeus, *Wied.*		
24. Lystrophis d'Orbignyi, *D. & B.*	=	Heterodon d'Orbignyi.
*25. Xenodon rhabdocephalus, *Boie.*		
*26. —— Neovidii, *Gthr.*		

	Cope.		Boulenger.
27.	Helicops infratæniatus, *Jan.*	=	Helicops carinicaudus, *Wied.*
28.	—— baliogaster, *Cope*, sp. n.	=	—— carinicaudus.
29.	Elaps altirostris, *Cope.*	=	Elaps lemniscatus, *L.*
30.	Bothrops alternatus, *D. & B.*	=	Bothrops alternatus.

BATRACHIA.

31.	Bufo d'Orbignyi, *D. & B.*	=	Bufo d'Orbignyi.
32.	—— marinus, *L.*	=	—— marinus.
33.	Engystoma ovale, *Schn.*	=	Engystoma ovale, var. bicolor.
34.	Hyla Vauterii, *D. & B.*	=	Hyla pulchella.
35.	—— pulchella, *D. & B.*	=	—— pulchella.
36.	Paludicola ranina, *Cope*, sp. n.	=	Paludicola gracilis, *Blgr.*
37.	Leptodactylus ocellatus, *L.*	=	Leptodactylus ocellatus.
38.	—— mystacinus, *Burm.*	=	—— mystacinus.
39.	Pseudis paradoxa, *Laur.*	=	Pseudis mantidactyla, *Cope*?

Observations on the above Identifications.

2, 3.—That the two new species, *Amphisbœna trachura* and *Aporarchus prunicolor*, the latter the type of a new genus, are identical with *A. Darwinii* I can affirm. The principal character upon which the former is founded, viz. the "several terminal rings of the tail very distinct and divided into prominent hard tubercles," is merely an individual anomaly. A species has already been made on a somewhat similar peculiarity (*A. heterozonata*, Burm.), but has been justly referred to the synonymy of *A. Darwinii* by Strauch, who has examined the type specimens. The new genus *Aporarchus* "is simply *Amphisbœna* without preanal pores." *A. prunicolor* is nothing but a young specimen in which the pores are undistinguishable (or absent), as I have myself observed among the numerous specimens of *A. Darwinii* which have lately passed through my hands. Strauch also mentions a specimen of an Amphisbænoid (*Anops Kingii*) abnormally destitute of preanal pores.

8.—Very curiously a colour variety of *Elapomorphus lemniscatus* has been described three times within two months:—by Strauch as *Elapomorphus Iheringii*, sp. n.; by myself as a variety of *E. lemniscatus*; and by Cope as *Phalotris melanopleurus*, sp. n. I have already shown that the characters given by Strauch do not even justify a subspecific distinction. This is further confirmed by Cope's description; while Strauch gives as unique structural character of his new species, as compared with *E. lemniscatus*, a very broad snout, Cope describes the snout as narrow; and he also remarks

that one of his specimens presents a black vertebral line which is absent in the others, the only remaining character upon which both descriptions agree being the continuous black colour of the lower and lateral surfaces. Since my remarks on the variations of this snake were written, the Natural-History Museum has received a ninth specimen, collected by Dr. v. Ihering at S. Lorenzo. This is larger than any hitherto recorded, measuring 700 millim.; snout very broad; coloration typical; ventrals 207, anal divided, caudals 23.

10.—Two closely allied species of *Liophis* occur abundantly in the province Rio Grande do Sul, one with nineteen rows of scales, the other with seventeen. The former was referred by me to *L. Merremii*, auct. (*C. meleagris*, Shaw), a view also taken by Cope. The second species I put down as *L. cobella*, to which it comes nearest, and of which an identical specimen was already so named in the Natural-History Museum; this is the form now named *Opheomorphus fuscus*. Whether it really deserves to rank as a species or ought to be regarded as a race of *L. cobella* is a doubtful question. At any rate it is a distinct form, characterized by the coloration and a somewhat greater number of ventral shields. Cope counts 182 ventrals, but this must be an extreme; the nine specimens before me give the following numbers:—165, 166, 167, 168, 170, 170, 172, 174, 175. In a dozen specimens of the typical *L. cobella* I find the number of ventrals varies from 143 to 161.

13.—After careful comparison of the description of *Apophis cyanopleurus* with the specimens identified by me as *Dromicus melanostigma*, Wagl., as well as with the figure of the type specimen published by Jan, I have no doubt the two forms are identical.

27, 28.—The two species of *Helicops* mentioned by Cope are identical, and I have at present before me specimens of both, as well as of *H. carinicaudus*, of which I regard them as varieties. Cope himself, it is true, remarks of his *H. baliogaster* that "this species is near the *H. infratæniatus*, Jan, and future investigation may prove it to be a variety of that species. . . . The colour of the lower surface in the two species is quite different." I can assure him that the latter difference does not even indicate a constant variety, as one of Dr. v. Ihering's specimens represents the typical *H. infratæniatus* on the anterior half of the ventral surface and the *H. baliogaster* on the posterior.

35, 36.—A number of specimens of *Hyla pulchella* obtained by Dr. v. Ihering have convinced me that the difference in the dentition upon which *H. Vauterii* has been separated from that species is merely individual, and I therefore unite the two.

37.—The description of *Paludicola ranina* agrees with my *P. gracilis*, published in January 1883, but which Prof. Cope appears to have overlooked.

40.—The occurrence so far south of *Pseudis paradoxa* would be surprising; but as the list does not mention *P. mantidactyla*, which is very abundant in the province, I cannot help suggesting that an error in the determination has been made.

In conclusion, I think not one of the new species described in Prof. Cope's paper deserves to stand, with the exception, perhaps, of *Liophis fuscus*. His list contains only seven species not recorded in mine; of these, four have already been mentioned from Rio Grande do Sul by Hensel, viz.:—*Drymobius pantherinus*, *Philodryas Olfersii*, *Xenodon rhabdocephalus*, and *X. Neovidii*. *Tachymenis hypoconia*, *Leptognathus Catesbyi*, and *Oxyrhopus plumbeus* are apparently recorded from that province for the first time.

XXIX.—*On a Collection of Lepidoptera made at Manipur and on the Borders of Assam by Dr. George Watt.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

[Plate VIII.]

In the year 1880 I had the pleasure of bringing before the Zoological Society an account of a collection made by Dr. Watt (Professor of Botany in the Calcutta University) principally in North-west India, and containing eight new species. Shortly after the publication of this paper Dr. Watt returned to India with the intention of starting immediately to explore Manipur; I, however, heard nothing more of him until the autumn of 1883, when he forwarded a large box of Lepidoptera in envelopes, and amongst them a smaller box of mounted specimens of all the species taken in Manipur, the remainder of the species having been obtained "on the N.E. frontier of India bordering on Assam."

Thirty-five species were obtained at or on the approach to Manipur, of which the following is a list :—

Caduga melaneus, *Cr.*
Ypthima nareda, *Koll.*
Thaumantis diores, *Dbl.*
—— camadeva, *Westw.*
Moduza procris, *Cr.*
Athyma cama, *M.*
Rahinda hordonia, *St.*
Euthalia teuta, *Dbl.*
Symphædra dirtea, *F.*
Eulepis samatha, *M.*
Prothoë regalis, *Btl.*
Euripus halitherses, *Westw.*
Myrina etolus, *F.*
Dercas Verhuellii, *Hoev.*
Ixias evippe, *Dr.*
Hebomoia glaucippe, *L.*
Prioneris thestylis, *Gr.*
Appias galba, *Wall.*
Appias eleonora, *B.*
—— vacans, *Btl.*
Hiposcritia lalage, *Gr.*
—— pseudolalage, *M.*
—— argyridina, *Btl.*
—— shiva, *Swin.*
—— mahana, *M.*
Huphina nama, *M.*
Ganoris gliciria, *Cr.*
Papilio antiphates, *Cr.*
—— doson, *Feld.*
—— acheron, *M.*
—— sarpedon, *L.*
—— agamemnon, *L.*
—— xenocles, *Gr.*
Protoparce orientalis, *Btl.*
Amesia aliris, *Dbl.*

There is therefore nothing in the Lepidoptera received in the present collection, with the exception of the Malayan genus *Prothoë* and the new species of *Hiposcritia*, which might not have been obtained at Assam; even the presence of *Prothoë* in Assam would not astonish me, since not a few Malayan types range quite as far northwards, even the same species being caught in Assam and Borneo; the present series from the vicinity of Assam fully bears out this fact.

Dr. Watt fully expected to remain at Manipur for three years, but was most unfortunately recalled soon after his arrival there; so that the collection is doubtless by no means so complete as we could wish; still, as next to nothing is known of its fauna, every addition must needs be welcome, and, considering how little opportunity Dr. Watt had of making a collection at all, owing to numerous other occupations, the series of species sent home by him is by no means an insignificant one.

Nymphalidæ.

Euplœinæ.

1. *Caduga melaneus*, var.

Papilio melaneus, Cramer, Pap. Exot. i. pl. xxx. D (1775).

Manipur.

Only one injured example of this species was obtained.

2. *Parantica melanoides.*

Parantica melanoides, Moore, P. Z. S. 1883, p. 247. n. 1.

One pair. Borders of Assam.

3. *Limnas chrysippus.*

Papilio chrysippus, Linnæus, Mus. Lud. Ulr. p. 263 (1764).

Males only. Near Assam.

4. *Salatura genutia.*

Papilio genutia, Cramer, Pap. Exot. iii. pl. ccvi. C, D (1782).

Three pairs. Near Assam.

5. *Tirumala septentrionalis.*

Danais septentrionalis, Butler, Ent. Month. Mag. xi. p. 163 (1874).

Three pairs. Near Assam.

6. *Danisepa rhadamanthus.*

Papilio rhadamanthus, Fabricius, Ent. Syst. iii. 1, p. 42. n. 127 (1793).

A male. Near Assam.

7. *Penoa alcathoë.*

Danais alcathoë, Godart, Enc. Méth. ix. p. 178. n. 5 (1819).

♂ ♀. Near Assam.

8. *Penoa deione.*

Euplœa deione, Westwood, Cab. Orient. Ent. pl. xxxvii. fig. 3 (1848).

A male. Near Assam.

9. *Trepsichrois Van-Deventeri.*

Trepsichrois Van-Deventeri, Forbes, Nat. Wand. p. 274 (1885).

A series. Near Assam.

10. *Isamia irawada.*

Euplœa irawada, Moore, Ann. & Mag. Nat. Hist. ser. , vol. xx. p. 45 (1877).
Isamia irawada, Moore, P. Z. S. 1883, p. 311. n. 2.

One beautiful male. Near Assam.

Satyrinæ.

11. *Anadebis himachala.*

Mycalesis? himachala, Moore, Cat. Lep. E. I. Co. i. p. 234. n. 503 (1857).

One poor specimen. Near Assam.

12. *Lethe latiaris.*

Debis latiaris, Hewitson, Exot. Butt. iii. *Debis*, pl. i. fig. 4 (1862).

♀. Near Assam.

13. *Lethe verma.*

Satyrus verma, Kollar, in Hügel's Kaschmir, iv. 2, p. 447, pl. xvi. figs. 1, 2 (1848).

♀. Near Assam.

14. *Callerebia orixa*, var.

Callerebia orixa, Moore, P. Z. S. 1872, p. 555.

♂. Near Assam.

Differs from the typical male (from the Khasia Hills) in the narrower zone to the ocellus of the primaries, which is also more oval in form, the obsolete character of the ocellus on the secondaries, and the absence of the ocelli and greyer tint on the under surface of these wings: it may prove to be distinct; but as only one somewhat rubbed example was obtained, it would at present be premature to separate it.

15. *Pachama mestra*, var.

Mycalesis mestra, Hewitson, Exot. Butt. iii. *Mycal.* pl. i. figs. 2, 3 (1862).

♂. Near Assam.

The single example obtained differs from the type in its slightly smaller ocelli, the narrower white band, and greyish instead of whitish sinuated submarginal stripe on the underside.

16. *Calysisme peribœa*?

Papilio peribœa, Fabricius, Ent. Syst. iii. 1, p. 234. n. 730 (1793).

♀. Near Assam.

The single example obtained is somewhat worn and shattered; it corresponds fairly well with the description by Fabricius, but may be distinct; it chiefly differs from *C. mamerta* of Cramer in the greater width of the yellowish-white band on the under surface, the general greyish coloration, the

greater width between the two submarginal lines, the inner one of which is less strongly undulated, and the smaller and less prominent ocelli, only two on the under surface of the primaries being at all easily seen.

17. *Gareris sanatana.*

Mycalesis sanatana, Moore, Cat. Lep. E. I. Co. i. p. 231. n. 489 (1857).

♂. Near Assam.

18. *Ypthima nareda.*

Satyrus nareda, Kollar, in Hügel's Kaschmir, iv. 2, p. 451 (1848).

Two pairs. Manipur, Nov. 15th.

The specimens are unfortunately much shattered.

19. *Ypthima methora.*

Ypthima methora, Hewitson, Trans. Ent. Soc. ser. 3, vol. ii. p. 291, pl. xviii. figs. 20, 21 (1865).

A pair. Near Assam.

20. *Ypthima ordinata?*

Ypthima ordinata, Butler, P. Z. S. 1880, p. 148. n. 5, pl. xv. fig. 3.

♀. Near Assam.

The single example obtained is a good deal worn; it agrees far more closely with *Y. ordinata* than with any other species hitherto described, especially in the size of the metallic pupils to the ocelli of the primaries and in general coloration: the ocelli on the under surface do not, however, form a perfect series, as in my type; they are a little smaller, and arranged in pairs. The type of *Y. ordinata* was from Bengal.

Elymniinæ.

21. *Elymnias leucocyma.*

Biblis leucocyma, Godart, Enc. Méth. ix. p. 326. n. 3 (1819).

♀. Near Assam.

Morphinæ.

22. *Thaumantis diores.*

Thaumantis diores, Doubleday, Ann. & Mag. Nat. Hist. ser. 1, vol. xvi. p. 234 (1845).

Three examples. Manipur.

The specimens are a little worn; two of them are males.

23. *Thaumantis camadeva.*

Thaumantis camadeva, Westwood, Cab. Orient. Entom. pl. iv. (1848).

Eight beautiful specimens. Manipur.

Nymphalinæ.

24. *Argynnis Childreni.*

Argynnis Childreni, G. R. Gray, Zool. Miscell. p. 33 (1841); Lep. Ins. Nepal, p. 11, pl. xi. (1846).

Two males. Near Assam.

25. *Argynnis niphe.*

Papilio niphe, Linnæus, Syst. Nat. i. 2, p. 785. n. 208 (1767).

A series of both sexes. Near Assam.

The specimens of this and most of the Assamese species which were obtained by Dr. Watt during his journey are in a much rubbed and generally worn condition, whereas those obtained at Manipur are carefully collected, and consequently in a very fair state of preservation.

26. *Cirrochroa aoris.*

Cirrochroa aoris, Doubleday and Hewitson, Gen. Diurn. Lep. pl. xxi. fig. 1 (1848).

♂. Near Assam.

27. *Cirrochroa rotundata.*

Cirrochroa rotundata, Butler, Trans. Linn. Soc., Zool. (2) i. p. 543 (1877).

Near Assam.

Fourteen more or less worn specimens were obtained.

28. *Atella sinha.*

Terinos sinha, Kollar, in Hügel's Kaschmir, iv. 2, p. 438 (1848).

Near Assam.

29. *Cethosia biblis.*

Papilio biblis, Drury, Ill. Exot. Ent. i. pl. iv. fig. 2 (1773).

♂. Near Assam.

30. *Cethosia cyane.*

Papilio cyane, Drury, Ill. Exot. Ent. i. pl. iv. fig. 1 (1773).

♂ ♀. Near Assam.

31. *Parthenos gambrisius.*

Papilio gambrisius, Fabricius, Ent. Syst. iii. 1, p. 85. n. 264 (1793).

♂. Near Assam.

32. *Modusa procris.*

Papilio procris, Cramer, Pap. Exot. ii. pl. cvi. E, F (1779).

Manipur.

33. *Athyma cama.*

Athyma cama, Moore, Cat. Lep. E. I. Co. i. p. 174, n. 357, pl. v. *a.* fig. 5 (1857).

♂. Manipur.

34. *Athyma selenophora.*

Limenitis selenophora, Kollar, in Hügel's Kaschmir, iv. 2, p. 426, pl. vii. figs. 1, 2 (1848).

♂. Near Assam.

35. *Athyma zeroca.*

Athyma zeroca, Moore, P. Z. S. 1872, p. 564.

♂. Near Assam.

36. *Athyma mahesa.*

Athyma mahesa, Moore, Cat. Lep. E. I. Co. i. p. 176. n. 360, pl. v. *a.* fig. 7 (1857).

♂. Near Assam.

One somewhat melanized specimen, evidently belonging to this species.

37. *Athyma inarina.*

Athyma inara, Moore (nec Doubl.), P. Z. S. 1858, pl. 50. fig. 6.

A comparison of the two figures representing *A. inara* will at once decide their specific distinctness, the commoner species figured by Moore having the orange and white bands considerably narrower than in the typical form represented in the 'Genera of Diurnal Lepidoptera.'

♂. Near Assam.

38. *Athyma leucothoë.*

Papilio leucothoë, Linnæus, Mus. Lud. Ulr. p. 292 (1764).

♂. Near Assam.

39. *Neptis*, sp. n.

Allied to *N. intermedia*, but too much damaged to be fit for description, especially from a unique example.

Near Assam.

40. *Neptis mananda.*

Neptis mananda, Moore, P. Z. S. 1877, p. 586, pl. lviii. fig. 4.

Near Assam.

41. *Neptis astola.*

Neptis astola, Moore, P. Z. S. 1872, p. 560.

Near Assam.

42. *Neptis Swinhoei.*

Neptis Swinhoei, Butler, P. Z. S. 1883, p. 145. n. 4.

Near Assam.

43. *Rahinda hordonia.*

Papilio hordonia, Stoll, Suppl. Cramer, pl. xxxiii. figs. 4, 4 *d* (1790).

"Ascent to Manipur from Cachar, Dec. 1881."

44. *Euthalia teuta.*

Adolias teuta, Doubleday and Hewitson, Gen. Diurn. Lep. pl. xliv. fig. 2 (1850).

♂. "Barak river, on ascent to Manipur, Dec. 1881."

45. *Symphædra cyanipardus.*

Symphædra cyanipardus, Butler, P. Z. S. 1868, p. 613. n. 4.

♂. Near Assam.

46. *Symphædra dirtea.*

Papilio dirtea, Fabricius, Ent. Syst. iii. 1, p. 59. n. 184 (1793).

♂. Manipur.

47. *Apatura chevana.*

Athyma chevana, Moore, P. Z. S. 1865, p. 763, pl. xli. fig. 1.

♂. Near Assam.

48. *Eulepis samatha.*

Charaxes samatha, Moore, P. Z. S. 1878, p. 831.
Eulepis samatha, Moore, Lep. Ceylon, i. p. 29, pl. xiv. figs. 2 *a*, 2 *b* (1880).

Mylang River, Dec. 1881.

49. *Haridra agna.*

Charaxes agna, Moore, P. Z. S. 1878, p. 832.

♂. Near Assam.

50. *Haridra hindia.*

Charaxes hindia, Butler, Lep. Exot. p. 99, pl. xxxvii. fig. 5 (1872).

♂. Near Assam.

51. *Haridra khimalara.*

Charaxes khimalara, Butler, Lep. Exot. p. 97, pl. xxxvii. fig. 1 (1872).

♂. Near Assam.

52. *Haridra dolon.*

Charaxes dolon, Westwood, Cab. Orient. Ent. pl. xxvii. figs. 2, 3 (1848).

Near Assam.

53. *Prothoë regalis.* (Pl. VIII. fig. 1.)

Prothoë regalis, Butler, Ann. & Mag. Nat. Hist. vol. xvi. pp. 53, 54 (July 1885).

Basal third of wings and body above olive-green: primaries crossed obliquely from the middle of costa to the third fourth of the inner margin by a broad silvery-blue belt, the external edge of which is irregularly notched and only separated by a blackish submarginal streak from three large spots of the same colour upon the centre of the external border; veins slenderly black, terminating in blackish spots, two of which are placed between the above-mentioned blue spots; two white spots followed by a blackish streak upon the costal part of the blue belt; a large triangular black spot closing the discoidal cell; apical area chocolate-brown; three subapical spots, the upper two large, placed obliquely, bluish, with white centres, the third submarginal, bluish, small: secondaries with the centre of the wing blue-black; apical area and external border chocolate-brown; two linear apical blue dashes and a blue line along the base of the fringe.

Under surface of primaries whity brown, slightly tinted with greenish towards the base and with lilacine along the external border; markings very similar to those of *P. Francki*, but the outline-spots on the discoidal area filled in with dark olivaceous, with no trace of an oblique white band and with all the internervular submarginal markings cruciform: secondaries with the basal half as in *P. Francki*, excepting that the discoidal spots are filled in with dark olivaceous; external half considerably darker, its inner half greyish olivaceous, enclosing a series of oblong internervular black patches, which are sinuated in front and bounded by reddish crescentic borders; immediately beyond these reddish crescents is a submarginal series of eight unequal black-edged bronze-green spots, with brighter green borders; these spots are irrorated and more or less suffused with blackish; from apex to second median branch is a series of gradually increasing marginal black spots, edged externally with pink, the last two crossed by a red stripe; a large bright olive-green semicircular spot, with black inner border and bluish-white outer border at outer extremity of first median interspace, and a large black spot, crossed by a red Λ-shaped marking, and bordered along its infero-exterior border with grey, at extremity of interno-median area; a triangular black and red spot at extremity of abdominal fold. Expanse of wings 80 millim.

Manipur.

On the upper surface this beautiful species may be at once distinguished from *P. Francki* of Java by the broader, more irregular, and greyer blue belt across the primaries, the absence of a white band on this belt, the blue marginal spots, and the blue or bluish subapical spots; the secondaries also have blue instead of white marginal dashes at apex, and the external border and apical area are chocolate-brown instead of purplish brown.

54. *Eurhinia fulva.*

Rhinopalpa fulva, Felder, Wien. ent. Monatschr. iv. p. 399. n. 21 (1860).

Near Assam.

55. *Cyrestis thyodamas.*

Cyrestis thyodamas, Boisduval, in Cuv. Règne Anim. Ins. ii. pl. cxxxviii. fig. 4 (1836).

Near Assam.

This species has long been confounded with the following, which, if not distinct, must surely, I think, be a seasonal form; it has probably been assumed (without examination) to be the female of *C. thyodamas*.

56. *Cyrestis ganescha.*

Amathusia ganescha, Kollar, in Hügel's Kaschmir, iv. 2, p. 430, pl. vii. figs. 3, 4 (1848).

Near Assam.

This is a yellow insect, with most of the markings on the wings of a deeper yellow, a few only remaining black; the apical area is not smoky brownish, as in *C. thyodamas*. If it be a seasonal form of the preceding, one form must have been just disappearing as the other emerged from pupa, for in no other way can one account for both of them having been taken by Dr. Watt at about the same time.

57. *Euripus halitherses.*

Euripus halitherses, Westwood and Hewitson, Gen. Diurn. Lep. pl. xli. fig. 2 (1850).

♂. "Ascent to Manipur from Cachar, Dec. 1881."

Only a single damaged specimen was obtained; the female (which we have received from Cachar) is the form to which Mr. Moore gave the name of *Hestina isa*; we have it also in both sexes from Darjiling.

58. *Junonia asterie.*

Papilio asterie, Linnæus, Syst. Nat. i. 2, p. 769. n. 133 (1767).

Near Assam.

59. *Junonia œnone.*

Papilio œnone, Linnæus, Mus. Lud. Ulr. pp. 274, 275 (1764).

Near Assam.

60. *Junonia orithyia.*

Papilio orithyia, Linnæus, Mus. Lud. Ulr. p. 278 (1764).

Near Assam (eighteen examples).

Under this name a number of local forms are usually associated, all of which appear to be constant. The true *J. orithyia* is a Chinese species; it ranges into Japan and Siam, but I am doubtful whether it is identical with the Indian form or forms; it certainly appears to be distinct from the species obtained by Col. Swinhoe in Mhow and Poona, a good series of which, owing to his liberality, we possess, and all of which are decidedly paler on the under surface than the Chinese insect, and have the pale markings on the apical area of the primaries above quite white; the latter form also

is uniformly smaller, and the blue areas upon the wings are less tinged with green. I think that in calling this local form *J. Swinhoei* I am separating as good and constant a type as that of Java, named *J. ocyale* by Hübner, that of Malacca, to which Mr. Distant has given the name of *J. Wallacei*, or that of Turkey and Arabia, recently named by Mr. Lang; those who maintain that all these forms should still be commingled under the name of *J. orithyia* are perfectly at liberty to hold that opinion—the fact of the existence of local differences still remains.

61. *Symbrenthia hippoclus.*

Papilio hippoclus, Cramer, Pap. Exot. iii. pl. ccxx. C, D (1782).

Near Assam.

62. *Hestina nama.*

Diadema nama, Doubleday, Ann. & Mag. Nat. Hist. xvi. p. 232 (1845).

Near Assam.

The genus to which the following species belongs has hitherto been placed in this part of the Nymphalinæ; I have, however, not the least doubt (in spite of its short thickened antennæ) that its proper place is in the Satyrinæ between *Zethera* and *Orinoma*; the neuration of the wings is almost identical with that of the latter genus. M. Oberthür's notion that *Calinaga* should be placed among the Papilionidæ shows that he has not examined its structure; no *Papilio* has aborted front legs.

63. *Calinaga brahma*, sp. n.

Nearly allied to *C. buddha*, but both sexes suffused with greyish, especially in the discoidal cell of primaries, so that the bands across and at the end of the cell are blurred and indistinct; the elbowed discal series of spots more or less suffused and reduced in size, as are also the spots beyond the cell of secondaries; the extremity of the cell in these wings is partly filled in with grey; the thorax is of a more orange tint than in *C. buddha*. Expanse of wings, ♂ 91 millim., ♀ 101 millim.

Near Assam.

Two males and a female were obtained.

64. *Ergolis merione.*

Papilio merione, Cramer, Pap. Exot. i. pl. lxxxvi. E, F (1779).

Near Assam.

65. *Kallima inachis.*

Paphia inachis, Boisduval, in Cuvier's Règne Anim. Ins. ii. pl. cxxxix. fig. 3 (1836).

Near Assam.

Acræinæ.

66. *Pareba vesta.*

Papilio vesta, Fabricius, Mant. Ins. ii. p. 14. n. 130 (1787).

Near Assam.

Fifteen examples were obtained, showing the usual variations in colour and pattern.

Erycinidæ.

67. *Zemeros flegyas.*

Papilio flegyas, Cramer, Pap. Exot. iii. pl. cclxxx. E, F (1782).

Near Assam.

68. *Abisara fylla.*

Taxila fylla, Westwood and Hewitson, Gen. Diurn. Lep. pl. lxix. fig. 3 (1851).

Near Assam.

[To be continued.]

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

June 10, 1885.—Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., President, in the Chair.

The following communication was read:—

"Note on the Sternal Apparatus in *Iguanodon.*" By J. W. Hulke, Esq., F.R.S., V.P.G.S.

The author remarked that although parts of the pectoral arch of *Iguanodon* had been identified in this country and in Belgium, nothing definite was known of the structure of the sternum itself, and stated that a specimen in the collection of Mr. Beckles, from the Wealden of Hastings, seemed to throw some light upon this point. The specimen in question consists of an azygos bar, from near one end of which two smaller rods diverge laterally, the latter terminating

mesially in expanded ends, applied to what the author regarded as the ventral surface of the azygos bar, where they approach each other very closely. These two diverging bones are regarded by the author as the clavicles. All the evidence tends to show that the parts are in their normal relations, in which case the clavicles bear the same relation to the interclavicle as in the pectoral arch of existing Lacertilia.

The azygos piece is a long flattened bar, widening posteriorly for some distance from the attachment of the clavicles, and then narrowing slightly to the posterior extremity. The lateral borders from the clavicles to the widest part are smooth and gently arcuate for the articulation of the epicoracoid; behind this they are rough and apparently non-articular. The author discussed the nature of the azygos piece, which evidently includes the interclavicle; but whether it comprises the costal sternum is questionable. There are no indications of the connexion of ribs with its lateral borders, and its figure is quite unlike that of the sternum in existing Lacertilia and Crocodilia. From all its characters the author concluded that the azygos piece represents only the interclavicle, and he suggested that the costal sternum may have been cartilaginous, as in existing Crocodiles.

June 24, 1885.—Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., President, in the Chair.

The following communications were read:—

1. "Note on the Zoological Position of the genus *Microchœrus*, Wood, and its apparent Identity with *Hyopsodus*, Leidy." By R. Lydekker, Esq., B.A., F.G.S.

In this paper the author discussed the characters of the genus *Microchœrus*, Wood, from English Upper Eocene deposits, which has hitherto been regarded as an Ungulate form, and showed that it is really an Insectivore. He also indicated that the American Eocene form *Hyopsodus*, Leidy, is almost certainly identical with *Microchœrus*.

2. "Observations on some imperfectly known Madreporaria from the Cretaceous Formation of England." By R. F. Tomes, Esq., F.G.S.

This communication contained notes on several species of Cretaceous corals. The author considered that *Smilotrochus insignis* of Duncan must be referred to the genus *Ceratotrochus*; that *S. granulatus*, Duncan, was founded on immature specimens of *Trochocyathus Wiltshirei*, Duncan; that *Micrabacia Fittoni*, Duncan, is a variety of *Cyclocyathus Fittoni*; that the genus *Podoseris*, Duncan, and probably *Syzygophyllum*, Reuss, are the same as *Rhizangia*, M.-Edw. and Haime, and consequently *P. mamilliformis*, Duncan, and *P. elongata*, Duncan, are species of *Rhizangia*. He further stated that *Turbinoseris*, Duncan, is identical with *Leptophyllia*, Reuss, and

as the specific name *de Fromenteli* is preoccupied in the latter genus, he proposed to substitute the name *Leptophyllia anglica*, Tomes, for *Turbinoseris de Fromenteli*, Duncan. A new species, probably of *Smilotrochus*, from the Gault of Folkestone, and a new *Isastræa* from Atherfield were described, and notes added on the occurrence in British localities of *Barysmilia tuberosa*, Reuss, *B. Cordieri*, M.-Edw. and Haime, *Pleurosmilia neocomiensis*, E. de From., of a small form of *Astrocœnia*, and of *Isastræa Reussiana*, M.-Edw. and Haime (= *Ulophyllia crispa*, Reuss). The occurrence of *Beaumontia Egertoni*, derived from the Carboniferous Limestone, in the Upper Greensand of Cambridge, was also recorded.

3. "On the Fossil Flora of Sagor in Carniola." By Constantin, Baron von Ettingshausen, F.C.G.S.

The author in this paper gave the principal results of his examination of the fossil flora of Sagor, consisting of 170 genera and 387 species, of which a list was appended. The plants were obtained from 14 different localities, some of the most important species from each of which were mentioned; in one of these localities the flora underlying the brown coal of the district belonged to the uppermost Eocene, whilst the remaining stations were assigned to the lowest stage of the Miocene system. The great diversity of the fossil plants showed that the Tertiary flora of this and other localities must be considered the origin of all the living floras of the globe; for in the fossil-flora of Sagor are found plants representative of forms now found in Australia, North America and Mexico, California, Chili, India and the East Indian islands, Europe, Africa, Norfolk Island, and New Zealand. Examples of all these were cited.

MISCELLANEOUS.

On the Brisingidæ of the Expedition of the 'Talisman.' By M. Edmond Perrier.

The family Brisingidæ, which I established in 1875 in my revision of the Stellerida, at first contained only the genus *Brisinga*, and appeared to be completely isolated in the class Stellerida. In his fine memoir on *Brisinga coronata* and *endecacnemos*, Ossian Sars approximated these remarkable animals to *Solaster*; but the form of their pedicellariæ demonstrated, on the contrary, very clearly that they must be referred to the Asteriadæ, and from that time I thought that it was advisable to group in the family Brisingidæ all the aberrant Asteriadæ which had only two rows of ambulacral tubes, that is to say *Pedicellaster* and *Labidiaster*. This is also the conclusion to which Dr. Viguier has been led in his 'Anatomie comparée du squelette des Stellérides'*.

This conclusion has since been fully confirmed by the study which Dr. Stüder and myself have been able to make of the *Labidiasteres* of the coast of Patagonia: but, further, the genera *Hymenodiscus*,

* Thèse de doctorat, 1879, p. 119.

E. P., and *Brisingaster*, de Loriol, have come to be added to this family, and to show that the diverse forms which it includes were of great interest in connexion with the morphology of the dorsal skeleton of the Stellerida. In fact I have made known one genus, the genus *Hymenodiscus*, in which this skeleton is wanting on the arms, which possess only the ambulacral and adambulacral pieces. To these pieces are added, in *Brisinga*, arcs of calcareous pieces supported by their extremities upon the adambulacral pieces, and which occur only in the region of the anus, which contains the generative apparatus. These arcs are still very little developed in *Brisinga mediterranea*, E. P. There exists only a single one for two pairs of adambulacral pieces in *B. endecacnemos* and *coronata*; there is one for each pair of adambulacral pieces in *B. Edwardsii*, E. P. Lastly in *Labidiaster* and *Brisingaster* there are added to these transverse arcs some longitudinal pieces which complete a calcareous network, closely resembling that which forms the dorsal skeleton of the Stellerida of the genus *Asterias*. Notwithstanding this, by the constitution of their disc and the number of their arms, the typical Brisingidæ remained separated from the Asteriadæ on the one hand, and from the *Pedicellasteres*, their nearest relatives, on the other. The new Brisingidæ collected by the 'Talisman' serve to fill up this gap, and at the same to extend the idea that we must form of the actual type of the *Brisingæ*. These Brisingidæ belong to six forms, which we propose to name *Brisinga robusta*, *B. semi-coronata*, *B. elegans*, *Freyella spinulosa*, *F. sexradiata*, and *Coronaster Parfaiti*. It is to be remarked that the form *B. coronata*, collected in abundance by the 'Travailleur' in the Bay of Biscay, proved to be comparatively rare after passing the latitude of Morocco, and was replaced by the new forms which have just been named.

Brisinga robusta is in a manner only an exaggeration of *B. coronata*. It possesses seventeen arms, much swelled in the neighbourhood of their base, and each attaining a length of more than two decimetres. Through its very thick integuments we cannot distinguish the prominent calcareous arcs, furnished with long spines, which are so distinct in *B. coronata*; but the disc and the bases of the arms are none the less bristling with very numerous and very strong spines. This form was captured off the Sahara, at depths of from 882 to 1435 metres. *Brisinga semi-coronata*, from the same regions, has likewise from fifteen to seventeen arms; but its arms are more slender, its disc is furnished with comparatively small spines, and the spines of the arms, which are less numerous and rather short, instead of being isolated on each side as in *B. coronata*, are arranged in a transverse comb on each side. *Brisinga elegans* is distinguished by its very characteristic flattened form, its broad and not very prominent disc all of a piece with the arms, which are slender, comparatively short, and furnished as usual with transverse calcareous arches, but very scantily spinous. The number of arms is nineteen; the colour rose-red. Fifteen individuals were dredged off the Pilones at a depth of 1435 metres. The three forms just characterized are true *Brisingæ*.

It is advisable, on the other hand, to create a genus *Freyella*

(from Freya, a Scandinavian goddess) for the form which I have named *B. Edwardsii*, and for the new forms *F. spinulosa* and *F. sexradiata*. In these forms all the inflated portion of the arms is in fact entirely covered with polygonal plates still arranged in not very regular arches, equal in number to the adambulacral plates in *B. Edwardsii*, of which we possess only one arm, but forming, on the contrary, a regular mosaic in *F. spinulosa* and *F. sexradiata*. This last form, obtained from a depth of 4060 metres, is remarkable for the small number of its arms, six only; *F. spinulosa*, on the contrary, has from eleven to fifteen, generally thirteen very long arms; it is of an orange-yellow colour, and when living diffuses a pretty strong alliaceous odour. It is met with from the Cape Verde to the Azores at depths of 2000–4000 metres. The *Freyellæ*, which are remarkable even by the peculiar construction of their skeleton, do not bear large spines like *B. coronata* or *robusta*; their skeletal plates are smooth in *F. Edwardsii*, furnished each with a small prickle in *F. sexradiata*, and with a transverse row of small spinules in *F. spinulosa*.

Lastly, the *Coronasteres* in appearance exactly resemble the species of *Asterias* of the group of *A. tenuispina*, and possess, like them, a dorsal skeleton reticulated with large meshes. But their ambulacral tubes are arranged only in two rows, and their spines are enveloped in a sheath which may ascend nearly to the apex and which bears an elegant fringe of pedicellariæ. The arms, which are very easily detached from the disc, as in the *Brisingæ*, are eleven in number. A single specimen was obtained at the Cape Verde Islands at a depth of 250 metres. *Coronaster* forms a term exactly intermediate between *Labidiaster* and *Asterias*, and the latter is thus closely affined to the *Brisingæ*, just as *Freyella sexradiata* leads directly from the *Brisingæ* to the *Pedicellasteres* with five and six arms. The *Brisingæ*, while still remaining very remarkable forms and comparatively isolated from the Ophiurans to which they were at first approximated, are thus, by the new discoveries, more and more distinctly united with the Stellerida properly so called. From the point of view of the development of the dorsal skeleton they may be arranged in an ascending series after the following fashion:—*Hymenodiscus Agassizii*, E. P.; *Brisinga mediterranea*, E. P.; *B. elegans*, E. P.; *B. endecacnemos*, Asbjörnsen; *B. coronata*, E. P.; *B. semi-coronata*, E. P.; *B. robusta*, E. P.; *Labidiaster radiosus*, Lovén; *Brisingaster Robillardi*, de Loriol; *Pedicellaster typicus*, Lovén; *Coronaster Parfaiti*, E. P.; *Asterias tenuispina*, Lamk. The *Freyellæ* form an aberrant series.—*Comptes Rendus*, August 10, 1885, p. 441.

On a new Species of Land-Tortoise, brought by M. Humblot to the Museum of Natural History. By M. Léon Vaillant.

The abundance and remarkable variety of specific types presented by the group of Land-Tortoises in Africa, and especially in the islands situated to the east of that continent, are facts which have long been known, and important memoirs have been published upon this subject, among which it is sufficient to refer to Dr. Günther's

memoir upon the gigantic Tortoises. One may therefore be astonished at finding in this region an animal of comparatively large size belonging to this group, and the characters of which do not allow of its being confounded with any other species of the genus. It is to one of our most zealous travellers, M. Humblot, that the Museum is indebted for this curious Chelonian. That naturalist, who was in possession of seven individuals of it, informs us that the present one, which is of the size of a large *Testudo radiata*, was not the largest, some of them being of nearly twice its dimensions.

The carapace is convex, generally hemispherical, with the anterior and posterior orifices not much raised, resembling that of *Testudo radiata*, Shaw. The dorsal shield presents a slight constriction in front, and is rounded behind; there is a nuchal shield, although it is very small. The form of the plastron particularly characterizes this species. The gular plate, instead of being double, as is usually the case in the Tortoises properly so called, is simple, as in the few species of which Gray proposed to form the genus *Chersina*; this, however, is only observed on the lower surface; on the upper surface there is a groove, an indication of the usual division. This plate and the bony part which supports it, distinct from the rest of the plastron, form a flattened, triangular process, twice as long as the width of its base, and bent from below upwards, a peculiar arrangement, the singularity of which struck M. Humblot, who observed it in his seven individuals.

The colour of the dorsal shield is yellowish red, with brown tints upon the periphery of the scaly plates of the disc and on the limb; the plastron, which is uniformly straw-yellow, shows some traces of a darker tint towards the margin of the abdominal plates. In fact the general coloration partakes at once of those observed in *Testudo radiata*, Shaw, and *Testudo* (*Chersina*) *angulata*, Dum.

These characters enable us at the first glance to distinguish this Chelonian from the other known true Tortoises; I propose to name it *Testudo yniphora*, in allusion to the peculiar form of the anterior part of the plastron.

Although the origin of this species cannot be precisely fixed, we may nevertheless regard it as certain, from the information furnished by the Arab sailors who sold these Tortoises to M. Humblot at the Great Comoro, that these animals had been captured upon an islet situated north-north-east of that place; moreover, considering the prevailing winds at the time, and the method of navigation adopted by these men, their vessel could only have come from this direction, that is from a locality situated towards Aldabra, perhaps even a dependency of that group of islands, where we know of such curious representations of the family Chersites.—*Comptes Rendus*, August 10, 1885, p. 440.

Orientation of the Embryo and Formation of the Cocoon in Periplaneta orientalis. By M. P. Hallez.

M. Hallez finds that each of the sixteen ovigerous tubes in *Periplaneta orientalis* contains a chaplet of ova gradually passing

down the tube towards the point of exit. He finds that throughout the organic axis of the ovum is parallel to the axis of the body of the parent, and, further, that the pole of the ovum which is directed towards the narrow part of the ovigerous tube, *i. e.* towards the head of the mother, is the cephalic pole of the ovum. The maturation of the ova goes on approximately *pari passu* in all the tubes, so that at a given moment each tube presents a mature ovum placed close to the calyx or oviduct, and oviposition and the formation of the cocoon are then imminent. He describes the latter process as follows:—

"The serific glands, as Léon Dufour calls them, form at this period a voluminous bundle ventrally situated and composed of very long tubes, coiled together, bifid and multifid. These tubes are filled with an opaque, readily coagulable substance, in which are disseminated an infinite number of crystals. They are prisms with a rhombic base, presenting a small rectangular facet of truncature in place of the projecting edges. They measure, on the average, 15 μ, are insoluble in water and in weak nitric acid; they are, on the contrary, destroyed without any disengagement of gas by concentrated sulphuric acid; and caustic potash dissolves them still more rapidly. These crystals are destined to the construction of the cocoon, which is formed by an assemblage of these crystals cemented by the coagulated substance in the midst of which they have originated.

"This cocoon, which Léon Dufour compares to a small, closed valise, is ovoid and presents a denticulated crest which is the line of dehiscence. The posterior extremity (that which issues first at the moment of delivery) is generally a little the thicker; the other is easily recognizable owing to the presence of a sort of small hilum. The line of dehiscence is superior, consequently corresponding to the dorsal surface of the insect. The eggs, sixteen in number, are arranged in two rows vertically in this cocoon; finally, in more than 100 cocoons that I have examined I have always found the heads of all the embryos directed towards the line of dehiscence.

"I have had the opportunity of observing directly the fabrication of the cocoon and the arrangement of the eggs in its interior. The two oviducts debouch a little in front of the subgenital plate at the superior level of the genital armature . . . . . . which is essentially formed of two episternites and of a sternite with two biramose branches. The whole forms a sort of funnel or speculum with four mobile branches, and placed obliquely from in front backwards, and from above downwards. The egg coming from the oviduct falls into this funnel, which seizes it and places it side by side with those previously laid; at the same time, by the combined mechanism of the walls of the genital sac and the pieces of the armature, the coagulable matter and its crystals are uniformly spread and take the form of the cocoon. The line of dehiscence is produced by a pressure exerted by the superior part of the sternite and perhaps also by the groove of the tergite of the anal segment. The cocoon is moreover supported beneath by the subgenital plates."

The egg always falls into the genital armature with the caudal pole downwards.—*Comptes Rendus*, August 10, 1885, p. 444.

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ERRATUM.

Page 240, 30th line from top. Add *not* before "aerial," and read the sentence:— "That the appendicular organs were *not* aerial roots," &c.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

No. 95. NOVEMBER 1885.

XXX.—*Critical Observations on Prof. Leidy's "Freshwater Rhizopods of North America," and Classification of the Rhizopods in general.* By Surgeon-Major WALLICH, M.D.

FROM the standpoint of the evolutionist any system of classification to be strictly natural must be based exclusively on such characters as are indicative of physiological advance in the class of organisms to which it is applicable; and, *à fortiori*, every system not so based, and which, in its application, is not even coincident with readily observable physiological advance, must necessarily be looked upon as retrogressive and misleading.

With such a self-evident axiom for our guidance it will probably be admitted by every biologist who is well read-up in the scientific literature of the Rhizopods that in no class of the Protozoa has multiplication of genera and species been carried to a pitch so reckless, and certain, if left unchecked, to plunge the nomenclature of the entire class into a state of inextricable confusion.

The plea most frequently urged in justification of this mania for species-manufacture is that it is essential for the purpose of identifying particular forms. But those who rely on this plea seem to forget that identification of mere varieties does not help us in identifying types, and therefore becomes one of the most vexatious obstacles in the way of natural classification; the greater the tendency to unlimited variation

in any particular group of organisms the greater being the evil effect of ignoring these considerations. Now it is universally allowed by all who have systematically studied the testaceous Amœbans, that these organisms are, of all others, the most liable to extreme variation, in virtue of their being the most likely to be affected by external conditions and purely local influences.

Ehrenberg, the great pioneer in microscopic natural history, in touching upon this subject observed that "in the remarkable mode of reproduction by self-division and the indifference of these minute independent beings to climatic variation there appear to reside characters which sufficiently distinguish them from larger beings, so as to make them preeminently adapted to a greater duration and extension through entire and successive formation-epochs of the earth."—*Phil. Mag.* (from Trans. Roy. Acad. Berlin, 1840).

This tersely-expressed opinion has been repeatedly borrowed by later writers without due acknowledgment, and coupled with occasional additions and alterations, which have not tended to improve, but to impair, its import. In allowing myself to render it more closely applicable to the particular group of organisms forming the subject of the present inquiry, it is my earnest wish not to fall under any such imputation.

The causes affecting the stability, extension by variation, and extinction of the Protozoan species follow a law which may be thus stated:—The lower the type the less liable is it to become extinct, but the more liable is it to undergo what may be termed constructive variation, inasmuch as its simple body-substance is least powerfully affected by changes in the material condition of the medium in which it lives, whereas its protective covering (should it possess one), the basis of which is invariably chitinoid, and consists of a permanently consolidated layer of ectosarc thrown off from the animal itself, is the first portion to be acted on by extraneous conditions. We are thus enabled to explain why the body-substance of the testaceous Rhizopods remains unaltered, whereas their protective covering presents an almost infinite varietal range both as regards the materials of which it is constructed and the form the construction assumes.

With these preliminary remarks before us, let us now inquire how far the most commonly accepted subdivision of the Rhizopods into orders, viz. that proposed by Dr. W. B. Carpenter, can be considered a natural one, bearing in recollection, however, that it is to the generic and specific subdivisions of the two most thoroughly known families, namely those

furnished with shell-like or chitinoid coverings, that attention is specially invited. The question of subdivision into orders, although of primary importance as regards the basis of every system of classification, being in reality of secondary importance for the purpose now in view, is imported into it solely in order to determine the position of *Gromia*, concerning which, as will be hereafter seen, there would still appear to be a great deal of misconception.

According to Dr. Carpenter, the subdivision into orders may be best accomplished by taking as a basis "those structural characters which are most expressive of physiological difference in the *form, proportions, and general arrangement of the pseudopodial extensions*; for notwithstanding their unrestrained polymorphism, the Rhizopods present three very distinct types of pseudopodian conformation, to one or other of which they may all be referred, *the group thus formed being eminently natural.*" Dr. Carpenter then proceeds to say that "in cases in which the differentiation into ectosarc and endosarc has proceeded furthest, so that the body of the Rhizopod bears the strongest resemblance to an ordinary cell, as is the case with *Amœba* and its allies, a *nucleus* may be distinctly traced; in those, on the other hand, in which the original protoplasmic condition is most completely retained (as seems to be the case in *Gromia* and with the Foraminifera generally), no nucleus can be distinguished" *.

In Dr. Carpenter's classification *Gromia* is consequently made the type of his lowest or Reticularian order, and is associated in that order with the Foraminifera only. The same basis of classification would seem to have been adopted by Prof. Huxley in his "Hunterian Lectures on the Invertebrata," delivered in 1867, when he described the Foraminifera as a group of Monerozoa containing some of the very simplest forms of life, one of the simplest of Foraminifera being *Gromia*, a jelly-like mass with extensile pseudopodia enclosed in a horny shell, differing from the imperforate Miliolidæ and Lagenidæ only in having a membranous or horny shell †.

In the Ann. & Mag. Nat. Hist. for June 1863 it was pointed out by me that the nuclear body with its capsular investment made its appearance for the first time in the two highest orders, and not in the lowest, which in my system

* 'The Study of the Foraminifera,' 1862, pp. 14 and 15.

† "Roy. Coll. Surgeons: Hunterian Lectures by Prof. Huxley, F.R.S., on the Invertebrata." (Abstract.) Quart. Journ. Microsc. Science, 1868.

comprises the Gromidæ, Foraminifera, and Polycystina, the nuclear granules being in this order diffused, and assuming the multiple character of sarcoblasts, which, on separation from the parent sarcode, constitute the primordial segment of the new brood. It was then also stated that the contractile vesicle does not make its appearance in the lowest order, namely the Herpnemata, or the intermediate order, the Protodermata, but occurs for the first time in the highest order, or Proteina, in which are associated together the Actinophrynæ, Lagynidæ, and Amœbidæ, both nucleus and contractile vesicle being invariably present in all the families of this order, although sometimes obscured from view in the testaceous genera. At the period referred to, viz. June 1863, neither of these two organs had as yet been noticed in *Gromia*; but a few weeks afterwards the discovery of the nucleus in this Rhizopod was announced as follows:—"As bearing directly on the characters of the Amœbidæ I have to record an important fact which revealed itself during my examination of the material containing *Amœba villosa*; I allude to the detection of a well-marked nucleus and nuclear capsule in *Gromia oviformis.* The contractile vesicle I failed to trace, but, in the presence of the manifest analogy existing between the Gromidæ and Lagenidæ, it is, I think, extremely probable that this organ also may yet be detected. Should it be so, the transfer of *Gromia* from the lowest to the highest ordinal type of Rhizopod structure would be rendered necessary."—*Annals*, Aug. 1863, p. 123.

Having followed up this subject still further, the following statement was made by me in the 'Annals' for December of the same year (p. 450):—"I may here repeat the statement made in the 'Annals' for August last, p. 123, that I had detected a distinct nucleus in *Gromia oviformis.* At a later period, but only once, I detected an equally distinct contractile vesicle. But until further opportunities present themselves of determining whether or not these two organs occur universally in all the members of the genus, I would reserve my final opinion on the subject." Finally, in a paper "On the Affinities of the Polycystina," read at the Royal Microscopical Society in May, and published in Quart. Journ. Microsc. Science for July 1865, my first tabulated classification of the Rhizopods appeared, the three orders being defined as shown opposite:—

No definite nucleus. No contractile vesicle.		Definite nucleus. No contractile vesicle.		Definite nucleus. Contractile vesicle.	
1.		2.		3.	
HERPNEMATA.		PROTODERMATA.		PROTEINA.	
Shell never siliceous.	Shell invariably siliceous.	Skeleton solid.	Skeleton tubular.	Pseudopodia monomorphous.	Pseudopodia polymorphous.
Foraminifera. Lieberkuhnia (*Clap.*)? Pamphagus (*Bail.*)?	Polycystina.	Plagiocanthidæ. Acanthometrina. Thalassicollina.	Dictyochidæ. ↓ Spongida.	Actinophryna. *Actinophrys.* *Gromia.* *Lagynis.* *Euglypha.* *Cadium* (Bail.). *Protocystis* (Wal.). *Plagiophrys* (Clap.).	Amœbina. *Amœba.* *Difflugia.* *Arcella.* *Pseudochlamys.*

Under the head of characters relating to the Proteina it was further stated that the presence of two such organs as the nucleus and contractile vesicle must be regarded as of primary importance, reasons having already been assigned for considering the degree of differentiation of the sarcodic body alleged to be deducible from the shape, form, proportions, and arrangement of the pseudopodia as of merely secondary value; and that, after a laborious study of the freshwater Proteina extending over nearly two years, without any important intermission, I felt satisfied that, even if made the basis of generic subdivision, these pseudopodian characters "are subject to a much wider range of variation than is usually imagined, not only in the same genus, but in the same individual at different periods of its existence" *.

It was during the above-mentioned continuous study of the Proteina that I verified the fact of the presence of a contractile vesicle in *Gromia* in a sufficiently large number of cases to place the matter beyond doubt. This was mentioned in a paper "On the Fundamental Error of constituting *Gromia* the Type of Foraminiferal Structure," published in the 'Annals' for Feb. 1877, p. 168.

Meanwhile, however, Dr. Carpenter had brought out the fifth edition of his most excellent treatise on 'The Microscope,' and had so far modified his views as to insert the following remark respecting the characters upon which he still depended for the subdivision of the Rhizopods into orders:—"It must be freely admitted," he said, "that these groups [the Reticularia, Radiolaria, and Lobosa] cannot be distinctly marked out, the typical examples which will now be described being connected by many intermediate forms. This is not to be wondered at when the extreme indefiniteness which characterizes the lowest type of animal life is duly borne in mind. . . . . In *Gromia*, moreover, we have an example of a Rhizopod which very characteristically exhibits the Reticularian type in the disposition of the pseudopodia, but which Dr. Wallich was the first to point out possesses both a nucleus and contractile vesicle, *thus showing a transition to the higher orders.*"—*Op. cit.* pp. 168, 169.

It needs no argument of mine to prove that a more illogical and hazardous conclusion could not have been drawn from so very significant a fact, for, instead of the altered position of *Gromia* being in anywise accounted for by at-

* For details of the grounds on which I rested my statements concerning the worthlessness of ordinal and generic characters derived from the pseudopodia see papers on the Rhizopods in the 'Annals' for Nov. 1863 and Dec. 1868.

tributing the previously so-called typical characters of its pseudopodia to its transitionary tendency, these characters, when taken in conjunction with the vastly more important presence of the nucleus and contractile vesicle, which alone indicate the true systematic position of the organism, proved at once that the Reticularian type, as well as every other pseudopodian type, could no longer be received as indicative of physiological advance, and consequently could no longer be considered of any practical value in the subdivision into orders of the various families of Rhizopods.

Having thus shown how the case stood in the year 1877, it will now be necessary to redirect our attention to the years 1863–4, when I called attention for the first time in the 'Annals' to the occurrence in this country and elsewhere of an extensive and highly interesting series of testaceous Rhizopods which, with three exceptions to be referred to hereafter, had not previously been described and figured by any other writer. Two of these excepted forms were included in Ehrenberg's famous work 'Die Infusionsthierchen,' published in 1839, but without any observations beyond a somewhat imperfect description of their external characters, due no doubt to the inferior nature of the microscopic appliances then available. In these circumstances, and in entire ignorance of the fact just stated, I described and figured the two forms in question, together with the remainder of the really new and typical varieties of *Difflugia* which had been discovered by me in India and in this country, in the 'Annals' for June and December 1863 and March 1864.

The whole of these forms, which, for reasons to be presently given, were referred by me to the genus *Difflugia*, threw an entirely new light on the relations borne by the animal to the shell, or (as it ought to be called in the case of the testaceous Rhizopods) the test *, which the animal inhabits but is only to a certain extent instrumental in constructing. The clue to this most interesting and till then novel fact had revealed itself to me in some of the living organic forms obtained in soundings made in the North Atlantic in 1860 on board H.M.S. 'Bulldog' †, the tubes of certain minute

* It would rid us of a very troublesome source of uncertainty and confusion were the term *shell* confined to the shells of the Foraminifera; *skeleton* or *framework* to the internal siliceous structure of the Polycystina, Acanthodesmidæ, and Dictyochidæ; and *tests* to the more or less chitinoid coverings of the Difflugidæ, Lagynidæ, and allied forms. As it is, these terms are employed indiscriminately and without any definite meaning attaching to each.

† 'The North-Atlantic Sea-bed,' G. C. Wallich, 1862, part 1, pp. 146, 147; and 'Biology of *Globigerina*,' 1876, pp. 11 and 12.

Annelids being invariably found made up of mineral particles, with sponge-spicules and minute Globigerine shells, or a mixture of these in proportion as the mud at the bottom of the ocean, on which the creatures lived, was more or less composed of varying quantities of these materials. This opens out a very important question, which may be expressed as follows:—Is there, or is there not, any connexion in a physiological sense between increased or diminished complexity of structure in the tests of the various testaceous families, and an increased or diminished complexity in the organization of the creatures inhabiting them? For, should the answer be in the negative, the only reasonable inference to be drawn from the facts is that mere differences in the material, mode of building up, and outward form and appearance of the tests, furnish no trustworthy characters for generic or even specific distinction. Or, to take the case of the Foraminifera, it equally becomes a question whether increased complexity in what Dr. Carpenter very appropriately calls "the plan of growth" of the shells can be regarded as indicating coexistent increase or decrease in the complexity of organization of the animal to which the tests belong. In this instance, however, it seems out of our power, in the present state of what ought to be termed our ignorance rather than our knowledge, to furnish any satisfactory answer, inasmuch as no means or methods of observation are available, even with the highest powers of the microscope, which can enable us to resolve those subtle traces of organization, the existence of which we may suspect, but cannot demonstrate. To assert, however, that highly complex functional effects take place in the bodies of these so termed unsurpassably simple creatures, in the absence of any adequate signs of organization, is so absurd that the wonder is that such a proposition should ever have been seriously propounded and unreservedly accepted. In touching on the same question in relation to a very different class of organisms, namely the Desmids and Diatoms, the case was thus stated by me:—"We know that complex vital processes are carried on in even the lowest types of being. But because we neither know nor are able to conceive *how* they are carried on we are not warranted in taking for granted that what appears to us, even with our most refined appliances, to consist of a mere particle of structureless jelly, must necessarily be as primordially simple as it appears"*.

To this opinion I would still adhere: but a voice infinitely

* "Are the Desmids and Diatoms 'Simple Cells'?" G. C. Wallich, 'Popular Science Review,' April 1877, p. 131.

more potent than mine has spoken on the same subject, and in words too pregnant with meaning and truth to be disputed. I allude to Prof. Tyndall, who writes as follows:—"Have the diamond, the amethyst, and the countless other crystals formed in the laboratory of nature and of man no structure? Assuredly they have; but what can the microscope make of it? Absolutely nothing. It cannot be too distinctly borne in mind that between the microscope and the true molecular limit there is room for infinite permutations and combinations. *It is in this region that the poles of the atoms are arranged, that tendency is given to their powers, so that when poles and powers have free action, proper stimuli, and a suitable environment, they determine first the germ and afterwards the complete organism.*"—*Fragments of Science*, London (6th edit.), 1879.

It only remains for me to point out that attention was not invited to the "potentialities" of organization in the sarcodic bodies of the Rhizopoda, with a view of bringing them to bear on the questions we are now engaged in investigating, but solely to show that the existence of these potentialities ought to be recognized, although for the present we must rest content to avail ourselves of such characters as are made palpable to our senses with the aid of the microscope.

This being clearly understood, let me observe that no satisfactory evidence has as yet been discovered of any generic difference between the animal we call *Amœba* and the animal we call a *Difflugia* beyond the palpable one which hinges on the fact of the former being a naked and the latter a testaceous Rhizopod. The sarcode-body in both presents the same degree of differentiation into what is known as endosarc and ectosarc. In both it is provided with a nucleus and contractile vesicle. In both there is a definite anterior and posterior part, the function of the latter being to exercise a certain degree of prehensile action, that is to say to the extent of regulating the movements of the body in the naked forms and maintaining its position within the test in the testaceous ones. In both there occur sarcoblasts, oil-globules, and crystalloids; and in both we may observe extensive vacuolation and the gradual development of a membranous investment of the entire body-substance when encystation is about to take place.

But if outward characters are to be taken at all as our guides, the identity of the two animals in *Amœba* and *Difflugia* can be shown in a still more striking manner. Thus it frequently happens that a Difflugian *Amœba* will vacate its test whilst under observation, and sally forth as a naked *Amœba* without appearing to have sustained any injury or

suffered any inconvenience. And it happens just as commonly that an ordinary naked *Amœba* will, whilst under observation, take summary possession of the first empty Difflugian or Arcellian test that comes in its way, and at once make itself quite at home in its new quarters; the newly-assumed characters being in each instance so perfectly sustained as to leave an observer who has not actually witnessed the transformation no reason to suspect the now testaceous form to have ever been otherwise than testaceous, or the now naked form otherwise than naked.

Other analogies and identities of procedure might be cited, as, for example, those connected with the process termed zygosis, of which nothing is in reality known, though several hypothetical explanations have been hazarded on the subject. So far, then, we encounter no anomaly; but should we push our investigations a step or two further we find ourselves confronted by what at first seems to be not only an unrecognized anomaly, but a paradox. And here *Gromia* retaliates on those who once degraded it, not only by refusing to throw any light on the difficulty, but by doing its best to lend force to it. Formerly, as we now are aware, *Gromia* was wrongly held to be the type of "the very simplest form of Foraminifer," by virtue of the so-termed Reticularian type of its pseudopodia. Yet in recognition of its possessing a nucleus and contractile vesicle, it has been promoted to the highest status in the Rhizopod scale. Its test is one of the simplest to be met with in the highest order, and, when it stood side by side with the simplest Biloculine Miliolidæ in the lowest order, was firmly believed to be just as simple in organization as they. But we have it on the authority of Dr. Carpenter, who probably knows more than any other man living of the structure and "plan of growth" of the shells of the Foraminifera (and any one who has under his guidance studied these exquisitely formed structures must have arrived at the same conclusion), that the Foraminifera, which stand at the very bottom of the Rhizopodal series in point of bodily organization, possess "*shells which are unsurpassed in symmetry and* complexity *of structure by any testaceous organisms*"*.

On the other hand, we see in the highest order of the Rhizopods the animal of *Difflugia* and its now firmly established compeer (as regards complexity of bodily organization) both in possession of protective coverings, the extreme *simplicity* of which is "unsurpassed by that of any other organisms!"

* 'The Study of the Foraminifera,' by Dr. Carpenter, F.R.S., 1862, Preface, p. viii.

In the case of the Difflugidæ there is no anomaly. For, although in the tests of the new forms to which I shall hereafter have occasion to refer in detail, some singularly striking characters become noticeable, there is, strictly speaking, no complexity in their construction *as imparted to them by the animal*, but only a very exceptional character, which carries with it indisputable evidence of not being the result of inherited idiosyncrasy, but of the variable nature of the conditions present in the medium in which the animal lives. This view was strongly urged by me in my paper in the 'Annals' for March 1864, and in a previous paper in the same Journal for Dec. 1863, in the following words:—"At the most, therefore, mere modifications in the shape and proportionate quantities of the organic and inorganic elements entering into the formation of the shell, ought to be employed only in discriminating between species."—*Annals*, June 1863, p. 452. And again:—"Assuming from the facts which have been advanced that the shape, materials, size, and colour of the Difflugian tests furnish characters so conspicuously variable as to yield no trustworthy criterion for even generic or even true specific distinction, and recalling to mind once more that the animal is in every instance specifically the same, it appears to me impossible to arrive at any other conclusion than that the whole of the subspecies, as well as their intermediate varieties (widely though some of these seem to differ from others in *external* features), have not only been derived by direct descent from a single progenitor, but may still continue to be produced by direct descent from varieties which become permanent *; and may one and all still be produced from a common archetype under the varying conditions to which these lower forms of life are subject. The animal does not vary, but it modifies the architecture of its habitation and the mineral material of which that habitation is in a great measure constituted, in obedience to local conditions and its own requirements."—*Annals*, March 1864, p. 239.

* "Permanent" only in the sense of being so as long as the conditions under which the species or variety first became established remain unchanged. When these conditions become gradually or suddenly modified, so do the species or varieties, but only in those respects in which the conditions effect a change in the animal itself, in its shelly covering, or in both combined. Thus, a dry season or a flood, or extreme degrees of temperature in the medium in which the animals live, scarcity or deterioration in the food-supply, one and all bring about modifications which then tell on their stability, their tendency to variation, or their extermination. This, in all probability, is the reason why we so often find some special form we have been accustomed to look for in a given locality, either replaced by a varietal form or gone altogether.

But it would obviously be the height of rashness and an indication of great want of discriminative tact to entertain the idea that what appears to be a rationally grounded explanation in the case just cited, stands on a par with that involved in the construction of all the varied and complex forms of Foraminiferal shell. Here we meet with presumptive evidence of the interposition of some faculty superior in kind to that by which the creature is enabled to select from the materials within its reach those materials best adapted for its requirements. That the Difflugidæ, in like manner with other Protozoa, do possess and are able to exercise some such faculty, is almost as certain as that two and two make four. Several extraordinary oceanic examples of this were recorded by me as long ago as the year 1858, and frequently since that period. But in the Foraminifer there resides not only a like selective power, when the necessity arises for its exercise, as we see in the case of the Lituoline and Arenaceous series generally, when seemingly forced to employ sandy or other particles for the consolidation of their shells on account of the supply of carbonate of lime held in solution in sea-water, falling short; but likewise a constructive faculty of so marvellous a nature as to leave us in a state of utter bewilderment at the beauty and symmetry of construction we see before us. For, be it observed, there is in this instance no tangible basis on which we could attribute what we see to the interference of some known extrinsic force, such as chemical affinity or a modified form of crystallization in presence of a colloid. In this dilemma how are we to account for so truly extraordinary a phenomenon exhibiting itself at the very bottom of the animal series?

On my own behalf I can only confess my utter inability to suggest a solution of the problem.

The inquiry having thus, step by step, reached the point at which any special group of characters observable in the testaceous Rhizopods under notice can be tested on the basis laid down in the opening paragraph of this paper, let us now turn our attention to Prof. Leidy's monograph on "The Freshwater Rhizopods of North America," the most recent and by far the most beautifully illustrated work on the subject that has hitherto been published *.

The first point deserving of notice is that Prof. Leidy does not offer any definite classification of his own of the freshwater Rhizopods, but confines himself to furnishing a more or less general outline of classification of the various systems proposed by Dujardin, Hæckel, Carpenter, Wallich, Huxley,

* Published at Washington in 1879, under the auspices of the "United States Geological and Geographical Survey of the Territories."

Carter, Hertwig, Greef, and others. Indeed, as he himself admits, "his attention has been more particularly directed to the discovery and determination of the various forms of Rhizopods occurring in North America, rather than to the elaboration of details of structure, habits, modes of development, and other matters pertaining to their history, though these have not been entirely neglected" (*op. cit.* p. 2).

The only portion of the volume that appears to me to fall short of the general standard of technical excellence is the purely bibliographical index, which is here and there rendered almost unintelligible through an undue multiplication of synonyms and the clerical errors which have occasionally crept into it. But its very compendiousness, which of itself must have involved a vast amount of labour, may well be allowed to turn the balance against any shortcomings of the kind referred to.

I sincerely wish certain errors in the work, of another kind, could be as easily passed by without further comment. Unfortunately, for reasons which will develop themselves as I proceed, they cannot be so. But when they are pointed out, I venture to think that, from whatever cause they may have arisen, Prof. Leidy himself will be the first to acknowledge them, quite as much in his own interests as in mine.

Nothing, therefore, of minor import to me personally than the facts about to be noticed could have induced me to criticise certain statements made by Prof. Leidy in reference to my published opinions concerning the freshwater Rhizopods, in a manner which, although unavoidably adverse, will, I trust, never appear hostile; more particularly as the United States Survey Department have done me the great honour of presenting me with a copy of his magnificent volume.

At page 7 Prof. Leidy makes the following remark:—"Dr. Wallich (Annals & Mag. Nat. Hist. 1863, xi. p. 438) divides the Rhizopods into three orders, the Herpnemata, Protodermata, and Proteina. In the first are included the Gromidæ, Foraminifera, and Polycystina; in the second the Thalassicollina and Acanthometrina; and in the third, the Actinophryna, Lagynida, and Amœbida."

As already stated, within a couple of years after the issue of the June 1863 number of the 'Annals' from which the above paragraph was taken, it was proved by me, not, as Prof. Leidy observes at p. 279 of his work, "in one instance," but in a sufficiently large number of instances to place the point at issue beyond dispute, that *Gromia* normally possesses both a nucleus and contractile vesicle, and must therefore, in spite of its "reticularian" pseudopodia, be

transferred from the lowest to the highest order of the Rhizopods. Had Prof. Leidy read the observations made by me at a somewhat later period (to which attention has been already drawn at pp. 322, 323, *ante*), he would have seen that, for the important reasons assigned, *Gromia* had been so transferred, and would, in all probability, therefore have accorded the fact as prominent notice as he accorded the statement contained in the paragraph above quoted. But he made the matter worse by stating at p. 279 of his work, without any further explanation, that—

"Prof. Schultze intimates the absence of a contractile vesicle in *Gromia* (Arch. f. mikrosk. Anat. 1875, p. 116); but *Dr. Wallich remarks that in one instance he detected this* temporary (!) *organ in Gromia oviformis*:" the most unintelligible part of the affair being that he should have stopped short in his quotation of my paper at the very point where my reasons were given for not deeming it expedient to speak positively about the presence of the contractile vesicle in *Gromia* on the strength of a single observation, and consequently determining to await its confirmation through a sufficient number of further observations.

I repeat, had Prof. Leidy cited the whole of the passage referred to, he might have been induced to consult two of my later papers, namely one on "The Affinities of the Polycystina" (mentioned in his Bibliographical list under my name), which was published in the 'Quart. Journ. Microsc. Science' for July 1865, and another "On the Fundamental Error of constituting *Gromia* the type of Foraminiferal Structure," published in the 'Annals' for Feb. 1877, and have thus avoided so obvious a misapprehension of my observations, and one so calculated to throw unmerited discredit on the entire basis of my classification.

But so completely did Prof. Leidy misinterpret or overlook my writings in relation to *Gromia*, that at p. 277 he expresses himself as follows, under the head of "Foraminifera:"—"These, though consituting the most extensive and important order of the Rhizopods, are almost exclusively marine. A single well-known genus, *Gromia*, is represented by several species inhabiting salt and fresh water;" and in the page following the last named, "The genus is of special interest *because it is a representative, in the simplest condition, of that great order of Rhizopods, the Foraminifera,* which are exclusively marine with the exception of the present one, *Gromia.*" And at pp. 278–279 he says that the body of *Gromia* "contained a large clear or pale granular nucleus situated centrically or eccentrically, and also variable proportions of

vacuoles. . . . . A vacuole was at times observed to gradually disappear; . . . . . but it was doubtful whether any of these corresponded with the contractile vesicle of other Rhizopods." He then gives a very good description of the characters of the only form of *Gromia* he had met with in North America, named by him *G. terricola*, partly on account of its habitat "in the crevices of the pavement in the yard attached to his home in the city of Philadelphia," and partly, I presume, owing to the animal having a habit of accumulating at the posterior portion of its test "more or less dirt consisting of fine granules and coarse particles of quartz sand" (p. 280). But beyond this his description of *G. terricola* would hold just as good for *G. oviformis*, or indeed any of the polymorphous varieties assumed by these organisms, for it presents no new characters.

The second erroneous statement I have to notice is even more extraordinary than the former one, inasmuch as it does not involve a misapprehension of my written opinions, but attributes to me statements which are directly opposed to those really made by me on the points in question. I allude to Prof. Leidy's assertion in relation to *Difflugia symmetrica* and the entire series of new testaceous forms, of which, with three before-mentioned exceptions, not one had been previously discovered, so far as I am aware, either in this country or elsewhere, prior to the appearance of my paper "On the Extent and some of the principal Causes of Structural Variation among the Difflugian Rhizopods," published in the 'Annals' for March 1864.

At pp. 150 and 151 of his work Prof. Leidy says, "The series of specimens represented by Dr. Wallich in figs. 27 to 33, pl. xvi. of the 13th vol. 'Annals & Mag. Nat. History' for 1864, and *described as transition forms of Difflugia symmetrica*, appear to me to pertain to the same animal as *Nebela collaris*."

It is not for me to hazard a conjecture how such a distorted view of my clearly-expressed opinion regarding the transitional series of forms referred to could have been arrived at by so careful an observer. At all events, I can positively affirm that I never entertained or expressed such an opinion. In all I wrote on the new varieties of the Difflugidæ I referred only to the outwardly visible characters of the tests for reasons already stated; and neither directly nor indirectly described "the *specimens* represented in my figures 27 to 33 of pl. xvi.," as "transition forms of *Difflugia symmetrica*." What I did state was that I considered them all as varieties of *Difflugia proteiformis* or its variety *D. pyriformis*; and as such I must continue to regard them until some much more satisfac-

tory reasons for cancelling my title to priority and superseding the generic position to which I referred them shall have been produced than those offered in Prof. Leidy's volume.

In my observations on the Difflugian Rhizopods, in the 'Annals' for March 1864, above referred to, I endeavoured to show that the entire series of Difflugian tests represented in my plates are constructed by animals which, with no known exception, are generically as well as specifically identical. There is nothing improbable therefore in the assumption that the entire series in their *earliest* condition, that is to say when the chitinoid exudation of which the test is entirely composed makes its appearance around the sarcoblast, are identical in form. When we study forms obtained from a sufficiently wide geographical area we find many previously existing intervals between varieties bridged over; and if we note the differences in the external conditions by which the animals are surrounded, whether of locality or climate, we are able, generally speaking, to trace some relation between the peculiarities of the varietal forms and the physical agencies which have helped to produce them. But in the cases under notice, neither in the structure nor the degree of organization of the animal itself, nor in the outward figure of any of the forms of test, are there any differences to be detected which could distinguish them generically from their exact prototypes and counterparts in already well-known and established typical Difflugian forms. For, as I have always maintained, the changes brought about in the external characters observable in the tests of the new varieties described by me in the 'Annals' for March 1864, are purely dependent on contact of the chitinoid bases of the tests with materials present in the medium by which they are surrounded, and therefore ought not to be employed for generic or specific subdivision.

A great deal of additional evidence in the same direction might be now adduced from my previous writings did space allow. Before proceeding further I must therefore confine myself to offering a few brief remarks bearing directly on what has gone before.

Without the production of any satisfactory reasons for his statements or for taking such a step as giving a new generic name to *Difflugia symmetrica*, which, as he himself admits, had been first described by me, Prof. Leidy thus defines the new genus he has created under the name of 'QUADRULA:'—"Shell compressed pyriform, transparent, colourless, composed of square plates of chitinoid membrane arranged in transverse or more or less oblique series, in consecutive or

alternating order. Mouth inferior, terminal, oval. SARCODE COLOURLESS, HAVING CHARACTERS OF THAT OF *DIFFLUGIA*, &c." (*op. cit.* p. 142).

In describing the *species* he says:—"*Quadrula symmetrica*, the only representative of its genus, is remarkable for the peculiar construction of its shell, which is compressed *pyriform*. . . . . The general arrangement [of the plates] is like that of tiling with variable regularity. . . . They are not entirely disposed with the symmetry expressed by their name, for frequently smaller plates break the regular succession of larger ones, and sometimes one angle of a plate replaces that of a contiguous one" (*op. cit.* p. 143). And, again, "*Quadrula symmetrica* was first described" in 1863–64 "by Dr. Wallich, *under the name* of *Difflugia symmetrica*, from specimens found in England. It was more recently" (that is to say in 1875, or just eleven years after I described and figured it) "described, and referred to a new genus, by Prof. Schultze from specimens found near Dresden. Ehrenberg described the same as pertaining to three different species under the names of *Difflugia assulata*, *D. carolinensis*, and *D. leptolepis*. These, in 1871 (Abhandl. Akad. Wiss. Berlin, 1871, p. 246), with a number of other forms, he referred to a subdivision of *Difflugia* with the names of *Assulina* and *Hologlypha*. As, however, the latter would apply to the first members of the subdivision indicated, which appear to be *only varieties*, or at most two species of *Cyphoderia*, neither of the names could be considered as appropriately taking precedence of *Quadrula*, distinctly applied to *Assulina assulata*, the fourth member of Ehrenberg's list" (of 1871).

As a matter of fact, *Difflugia symmetrica* is *the only* aberrant member of my series of new testaceous Difflugidæ which was *not* included in the synoptical list given at p. 240 of the 'Annals' for March 1864, being then, as it is still, considered by me to have been sufficiently identified and defined in any classification having for its end a systematic arrangement based only on natural characters. Moreover, it seems extraordinary that the established rules of priority and nomenclature (to which Prof. Leidy here draws such marked attention) should, with his sanction, have been infringed by Prof. Schultze, when the latter writer, in 1875, superseded the generic name given to the form in question, at the same time retaining the specific name applied to it by me as distinctly indicative of its special character.

I venture to assert there is not a single new character assigned in Prof. Leidy's definition of the genus "*Quadrula*" (or, to use an expression of his, *Difflugia symmetrica* "under-

the name of" "*Quadrula symmetrica*") beyond those adduced by me, except one which I undertake to say is erroneous, namely that "the plates are either chitinoid or membranous." On the other hand, he undoubtedly furnishes the completest proof of the propriety of referring the form to the genus *Difflugia* when the only remark he has to make upon the animal is that the sarcode "has the same character as that of *Difflugia*." This ought to be borne clearly in mind, for Prof. Leidy subsequently speaks of *Quadrula symmetrica* as "the only representative of its genus."

But it is quite needless to argue the question of priority a step further, for I now have to place on record an important fact of which I was ignorant at the time I described *Difflugia symmetrica* in 1863–64, and discovered only within the present year, viz. that this identical form had been figured in Ehrenberg's 'Infusionsthierchen' as *a Difflugia*. Ehrenberg's subsequent remarks in the 'Proceedings of the Berlin Academy' and elsewhere, to which allusion is now made by Prof. Leidy, are altogether beside the question at issue, except to the extent of proving that Ehrenberg recognized the validity of my specific appellation of "*symmetrica*" and retained it. Of course, the moment I found I had overlooked Ehrenberg's title to priority (unfortunately too late to be made known to the illustrious dead), I determined on the first suitable occasion to cede all title to the discovery of *D. symmetrica*, though I was undoubtedly the first to detect it in this country, and to discover, describe, and figure the other new forms of testaceous Difflugidæ of which I shall have occasion to speak in the concluding part of this paper.

[To be continued.]

XXXI.—*On a Collection of Lepidoptera made at Manipur and on the Borders of Assam by Dr. George Watt.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

[Plate VIII.]

[Concluded from page 310.]

Lycænidæ.

69. *Cyaniris placida.*

Cyaniris placida, Moore, P. Z. S. 1883, p. 523, pl. xlviii. fig. 5.

Near Assam.

Only males of *C. placida* were obtained.

70. *Cyaniris puspa.*

Polyommatus puspa, Horsfield, Cat. Lep. E. I. Co. p. 67. n. 3 (1828).

♂. Near Assam.

Two of the three examples obtained seem a little aberrant, and may belong to a distinct but allied species; they are, however, in poor condition, and it is possible that the species may vary somewhat both in the width of the outer border on the primaries and in the size and prominence of the markings on the under surface. I have, however, failed to notice similar variation (excepting where due to seasonal polymorphism, as in the North-American species) in the allied species. I do not find any characters to warrant the separation of the other male from Horsfield's Javan type.

71. *Nacaduba ardates.*

Lycæna ardates, Moore, P. Z. S. 1874, p. 574, pl. lxvii. fig. 1.

Near Assam.

Four damaged males were obtained, no two of them absolutely alike in the pattern on the under surface of the primaries. A nearly allied "species" described by De Niceville (Journ. Asiat. Soc. Beng. vol. lii. p. 72, pl. i. fig. 13, 1873) is separated from the above by its superior size, by the abbreviation of the band crossing the cell on the under surface, and by the absence of the lowest spot in the discal series. The specimens before me vary from 22 to 24 millim. in expanse of wing; the band is only abbreviated in one of the larger specimens, and, though all have the full number of sections to the discal band, the last two sections (they can hardly be called spots) are sometimes in line and sometimes decidedly out of line; the failure of the last spot of a discal series or the last section of a discal band is of frequent occurrence in the Lycænidæ; therefore, since both *N. ardates* and *N. bhutea* appear to be common in Sikkim, I feel some doubt as to the validity of the latter as a distinct species; at the same time, with only the figure of this form before me I cannot positively assert that it is not distinct *.

72. *Lampides elpis.*

Polyommatus elpis, Godart, Enc. Méth. ii. p. 654. n. 125 (1823).

♂. Near Assam.

We have this species also from Silhet; the Indian examples

* I have, since the above was written, seen one imperfect specimen of *N. bhutea* in Mr. Moore's collection; I should certainly hesitate to describe so nearly allied a form myself.

are slightly more azure in tint than those from Java, but do not otherwise differ.

73. *Catochrysops lithargyria.*

Catochrysops lithargyria, Moore, Ann. & Mag. Nat. Hist. ser. 4, vol. xx. p. 340 (1877).

♂. Near Assam.

74. *Catochrysops strabo.*

Hesperia strabo, Fabricius, Ent. Syst. iii. 1, p. 287. n. 101 (1793).

♂. Near Assam.

75. *Myrina etolus.*

Papilio etolus, Fabricius, Mant. Ins. ii. p. 66. n. 620 (1787).

♂. Manipur.

Papilionidæ.

Pierinæ.

76. *Colias Fieldii.*

Colias Fieldii, Ménétriés, Cat. Mus. Petrop. Lep. i. p. 79, pl. i. fig. 5. (1855).

♂ ♀. Near Assam.

Dr. Watt obtained fifteen examples, the largest of which measures 64 millim. in expanse of wing, and thus compares favourably with *C. aurorina* of Europe. The smallest example in the Museum-series is one from the N.W. Provinces of India; it not only differs in its greatly reduced size and somewhat more produced primaries, but in its narrower borders, blackened veins, and pupilled discocellular spot; possibly it may be distinct; its expanse of wing is only 36 millim. I leave the question of the distinctness of these two forms until further material turns up; perhaps Mr. Elwes will be able to decide the matter.

Before passing on to the next genus (*Terias*) I feel called upon to say somewhat touching Mr. Distant's recent treatment of the genus (Lep. Malayana, pp. 302–307), which is based wholly upon the supposition that Mr. Pryer's experiments with Japanese species were as careful as he himself thought them. From long experience in plant-growing I know well that nothing is easier than to overlook such conspicuous objects as scale-insects, even though one fancies one has examined carefully every leaf of a plant; how much more so the small eggs of *Terias*! Mr. Pryer says

that he potted a number of plants, and after looking over them, or, in his own words, "carefully examining every leaf for eggs or larvæ," he placed upon them females of *Terias mandarina*, and the result was that he bred *T. mandarina* (at which he was greatly astonished, and immediately decided that this was a seasonal form of another species); he also bred *T. Mariesii* and some of the intergrades, which seem not to have astonished him at all.

Mr. Pryer's experiments may be satisfactory, or they may not; if the plants possessed a great number of leaves, the probability is that some eggs were overlooked; if they were roughly potted, it is not improbable that such eggs as were upon them fell upon the mould and were hatched there; but anyhow *T. mandarina* cannot be called a seasonal form of *T. Mariesii* or *T. hecabe*, if it produces itself.

Secondly, Mr. Distant expects that breeding will prove *T. sari* to be "only a variety of *T. hecabe*;" if so, why not expect the whole of the Old-World species to prove varieties of *T. hecabe*, since forms closer to *T. hecabe* than *T. sari* are found in all parts of Asia, Africa, and Australia? Is it reasonable to suggest that *T. sari*, a purely Malayan species, may be a variety of a species which ranges from Darjiling to the Philippines, or, at any rate, is at present assumed to do so (for it is doubtful whether all the specimens now referred to *T. hecabe* are rightly placed with that species). Mr. Distant remarks that breeding experiments have not yet proved that *T. sari* is a variety of *T. hecabe*; yet *Horsfield*, *Thwaites*, and *Mackwood* have all bred it, by his own showing. However I am willing to accept his admission—a rash one for an entomologist to make—"I treat this species as a variety" (see p. 321). I know of many lepidopterists who do this; but Mr. Distant is the first who has boldly come forward and confessed it.

77. *Terias venata?*

Terias venata, Moore, Cat. Lep. E. I. Comp. i. p. 65. n. 117, pl. ii. *a.* fig. 2 (1857).

Near Assam.

A pair of a *Terias* agreeing best with this species, but apparently distinct; I, however, consider that, as the differences are slight, two somewhat imperfect specimens are insufficient material upon which to separate this form from *T. venata*.

78. *Terias hecabeoides.*

Terias hecabeoides, Ménétriés, Cat. Mus. Petrop. Lep. i. p. 85, pl. ii. fig. 2 (1855).

♂. Near Assam.

This may eventually prove to be distinct from typical *T. hecabeoides*, the specimens being decidedly larger and more primrose-coloured than in the figure above quoted, which is nearer typical *T. hecabe*.

79. *Terias heliophila*, sp. n. (Pl. VIII. fig. 2.)

♂. Bright primrose-yellow: primaries above with a broad dark brown external border nearly as in *T. sari*, but with the sinus distinctly bisinuated; external border of secondaries moderately broad, a little less so than in typical *T. Mariesii*, with distinctly sinuated inner edge: under surface bright gamboge-yellow, with markings of *T. æsiope*, only less strongly defined; the apical streak of the primaries represented by two or three diffused red-brown spots. Expanse of wings 47 millim.

Near Assam.

Three male examples were obtained, but only one of them is in tolerable condition; the species, however, cannot be referred to anything hitherto described, its nearest ally being *T. maroensis* from Timor-Laut.

80. *Terias simulata.*

Terias simulata, Moore, Lep. Ins. Ceylon, i. p. 119, pl. xlv. figs. 2, 2 *a*, 2 *b* (1881).

Near Assam.

Five examples, in somewhat worn condition.

81. *Terias æsiope.*

Terias æsiope, Ménétriés, Cat. Mus. Petrop. Lep. i. p. 85, pl. ii. fig. 3 (1855).

♂ ♀. Near Assam.

Nine worn specimens were obtained.

82. *Terias irregularis.*

Terias irregularis, Moore, P. Z. S. 1882, p. 253, pl. xii. fig. 3.

♂. Near Assam.

83. *Dercas Verhuellii.*

Colias Verhuellii, Van der Hoeven, Tijd. Nat. Gesch. v. pl. viii. figs. 3, 4 (1838).

♂ ♀. Manipur.

Only one pair was obtained.

84. *Ixias evippe.*

Papilio evippe, Drury, Ill. Exot. Ent. i. pl. v. fig. 2 (1773).

Ten males. Manipur.

85. *Hebomoia glaucippe.*

Papilio glaucippe, Linnæus, Mus. Lud. Ulr. p. 240 (1764).

♂. Manipur.

86. *Prioneris thestylis.*

Pieris thestylis, Gray, Zool. Miscell. p. 76 (1842).

Manipur.

Seven males were caught, two of them not quite typical, the yellow angular belt on under surface being wider than usual. We have a similar example from Darjiling in the Museum series.

87. *Delias ithiela.*

Thyca ithiela, Butler, Ann. & Mag. Nat. Hist. ser. 4, vol. iv. p. 242 (1869).

♂. Near Assam.

Originally described from Penang, and on that account included by Mr. Distant in his admirable work 'Rhopalocera Malayana;' this locality, however, was an error arising out of the fact that the type was labelled thus—'P.,' which, with Wallace's specimens, stands for "Penang;" but with specimens received from the East India Company (as Mr. Moore pointed out some two or three years since on a ticket which he attached to this very species) it stands for "Darjeeling, *Pearson*." Had Mr. Distant examined my type, which, by his own admission, he did not do, he would have avoided the repetition of this error.

88. *Delias agostina.*

Pieris agostina, Hewitson, Ex. Butt. i. *Pieris*, pl. i. figs. 1, 2 (1852).

♂. Near Assam.

89. *Appias galba.*

Tachyris galba, Wallace, Trans. Ent. Soc. ser. 3, vol. iv. p. 378. n. 41 (1867).

Manipur.

Seven examples were obtained.

90. *Appias Eleonora.*

Pieris Eleonora, Boisduval, Sp. Gén. Lep. i. p. 481. n. 64 (1836).

♂ ♀. Manipur.

Out of twenty-four examples only one is a female.

91. *Appias vacans.*

Appias vacans, Butler, Trans. Ent. Soc. 1879, p. 490.

♂. Manipur.

Five males, agreeing exactly with typical *A. vacans* in the more sulphur-tinted colour of the under surface, by which character alone can I distinguish the males of this species from those of *A. Eleonora*, whereas the females differ widely enough. Mr. Moore's figure in 'Lep. Ceylon' better represents *A. Eleonora*, being decidedly too ochraceous for my male of *A. vacans*.

92. *Hiposcritia durvasa.*

Pieris durvasa, Moore, Cat. Lep. E. I. Comp. i. p. 73. n. 142 (1857); P. Z. S. 1857, pl. xliv. fig. 6.

Four males. Near Assam.

93. *Hiposcritia lalage.*

Pieris lalage, Gray, Zool. Miscell. p. 76 (1842); Doubleday & Hewitson, Gen. Diurn. Lepid. pl. vi. fig. 5 (1847).

Ten males. Manipur.

94. *Hiposcritia pseudolalage.*

♂. *Catophaga pseudolalage*, Moore, P. Z. S. 1879, p. 142.

Manipur.

Three males represent this species, but in so shattered a condition that they are chiefly valuable as indicating the existence of the species at Manipur.

95. *Hiposcritia argyridina*, sp. n.

♂. Above similar to *H. pseudolalage*, but usually smaller and with the spot on second median interspace better separated from the external border; basal area more silvery than in any of the allied species: below it differs in the apical area of primaries, and whole of secondaries being irrorated with brown, as in *H. mahana*, instead of pale buff. Expanse of wings 56–62 millim.

"January 8, 1881. Valley of the Khŏonah Khong, Eastern Ranges, Manipur.

"I was surprised on reaching the river to find a white butterfly in great abundance flying down the stream in strings of fifty to a hundred like ducks. I had a swing with my net and caught ten to fifteen at each turn. I don't remember to have seen this habit, nor indeed the insect before. Not a single specimen was seen flying up the river, nor one fluttering about; all seemed intent upon some definite journey down stream, each following his neighbour: if disturbed they changed their course for a time, but soon resumed it. I was still further surprised to find the same insect

in the woods adjoining, *singly*, loitering, but flying, upon the whole, up the valley."—*Dr. Watt.*

The female is in Mr. Moore's collection as that sex of *H. pseudolalage*; the latter, however, is much more like *H. lalage* on both surfaces; it is, however, smaller, has the anal half of the external border of secondaries partly divided by a submarginal macular grey streak, and on the under surface the basal area of these wings and the disco-submarginal dark grey line are far better defined. We have it from Darjiling, whence also all our male examples were received.

Dr. Watt sent home seventeen specimens of *H. argyridina*, but unfortunately the bulk of them were more or less damaged, probably having knocked one another about in the net. It is a significant fact that no other species was mixed up with them; had there been, it would have cast a doubt on the validity of the species in this group.

96. *Hiposcritia shiva.*

Hiposcritia shiva, Swinhoe, P. Z. S. 1885, p. 138. n. 106, pl. ix. figs. 1, 2.

Manipur.

Twenty-six examples were collected. Colonel Swinhoe says that it is "very much like a diminutive *H. narendra* above;" but the greater part of the specimens before me are quite as large and some even larger than that species; it varies in expanse of wing from 47 to 68 millim.; it varies also in pattern not a little, in the number and size of the white subapical spots on the primaries, in the prominence or entire absence of the black process of the external border on the second median interspace, in the absence or prominence of the colouring and marking of the under surface, most examples being almost as yellow as *H. durvasa* and with similar markings to those of *H. narendra*; nevertheless it perfectly holds its own as a distinct species.

97. *Hiposcritia mahana.*

♂. *Appias mahana,* Moore, Ann. & Mag. Nat. Hist. ser. 4, vol. xx. p. 48 (1877).

Wallace (Trans. Ent. Soc. 3rd ser. vol. iv. p. 382) speaks of this species, under a MS. name of Boisduval's, as apparently undescribed, and says that the name "should be altogether dropped;" he appears, however, not to have described the species. The latter is similar on the upper surface to *H. shiva*, but its female more nearly resembles that sex of *H. indra*, differing from it chiefly in its smaller size, less produced primaries, the complete submarginal series of white

spots on upper surface of secondaries, and the more dusky colouring of these wings on the under surface; the male differs on the under surface from *H. shiva* in the brownish irrorated character of the apical area of the primaries and whole of secondaries on the under surface, in which respect it corresponds with *H. pandione.* Expanse of wings, ♂ 59–65 millim., ♀ 68 millim.

One male. Manipur.

H. mahana is in the. Museum collection from Silhet and Calcutta.

98. *Huphina nama.*

Pieris nama, Moore, Cat. Lep. E. I. Comp. i. p. 76. n. 148 (1857); P. Z. S. 1857, pl. xliv. figs. 1, 2.

Twelve males. Manipur.

99. *Huphina phryne.*

Papilio phryne, Fabricius, Syst. Ent. p. 473. n. 131 (1775).

♂. Near Assam.

100. *Ganoris gliciria.*

Papilio gliciria, Cramer, Pap. Exot. ii. pl. clxxi. E, F (1779).

♂ ♀. Irang River, Dec. 1881.

Dr. Watt collected twenty-five examples of this species.

101. *Ganoris ajaca.*

Pieris ajaca, Moore, P. Z. S. 1865, p. 490. n. 21, pl. xxxi. fig. 16.

♂ ♀. Near Assam.

One pair only was obtained, both examples being a little larger than Moore's type, but not otherwise differing.

Papilioninæ.

102. *Papilio antiphates.*

Papilio antiphates, Cramer, Pap. Exot. i. pl. lxxii. A, B (1779).

Two examples. Manipur.

103. *Papilio doson.*

Papilio doson, Felder, Verh. zool.-botan. Gesellsch. xiv. p. 305. n. 222 (1864).

One example. Manipur.

104. *Papilio acheron.*

Zetides acheron, Moore, Ann. & Mag. Nat. Hist. vol. xvi. p. 120 (Aug. 1885).

Eight examples. Manipur.

105. *Papilio bathycles.*

Papilio bathycles, Zinken, Nova Acta Acad. Nat. Cur. xv. p. 157, pl. xiv. figs. 6, 7 (1831).

Seven specimens. Near Assam.

106. *Papilio sarpedon.*

Papilio sarpedon, Linnæus, Mus. Lud. Ulr. p. 196 (1764).

Six more or less worn examples. Manipur.

107. *Papilio agamemnon.*

Papilio agamemnon, Linnæus, Mus. Lud. Ulr. p. 202 (1764)

Manipur.
Three examples were obtained.

108. *Papilio xenocles.*

Papilio xenocles, Gray, Zool. Miscell. p. 74 (1842).

Manipur.
Four examples were taken.

109. *Papilio danisepa*, sp. n.

Allied to *P. caunus*, and mimicking *D. rhadamanthus*; it differs from the Bornean *P. caunus* in its superior size, the much longer costal margin of the primaries, the much larger white patch at the end of the cell, the better defined submarginal spots on the primaries, less numerous and smaller submarginal spots on the secondaries, and in having the basal half of the secondaries white crossed by black veins. Expanse of wings 120 millim.

One male. Near Assam.

In the Museum collection we have a male scarcely differing from the above, and evidently of the same species, from Silhet. In the Hewitson collection is a male from Borneo corresponding with our Bornean specimen; there are also two males from Sumatra differing from the latter much as *Danisepa diocletianus* does from *D. Lowii*; they agree with *P. caunus* in form of wing and are of about the same size, but differ in having nearly twice as much white at the base of the secondaries*. As there can be no reasonable doubt of their being constant to locality, I propose to name the Sumatran race *P. velutinus*. I have no doubt that the *P. caunus* of M. Oberthür's list, from Java, is a fourth form in which the basal white patch has almost disappeared, whilst that from Nias should have no patch at all.

* *P. ægialus*, Distant (Annals, vol. xii. p. 352), from Singapore, seems to differ in having much less white at base.

110. *Papilio helenus.*

Papilio helenus, Linnæus, Mus. Lud. Ulr. p. 185 (1764).

♂. Near Assam.

111. *Papilio ganesa.*

Papilio ganesa, Gray, Zool. Miscell. p. 73 (1842).

(Three specimens.) Near Assam.

112. *Papilio paris.*

Papilio paris, Linnæus, Mus. Lud. Ulr. p. 184 (1764).

♂. Near Assam.

113. *Papilio cacharensis,* sp. n.

Smaller and narrower in the wing than *P. Doubledayii*, to which it is most nearly allied; the white patch in the cell of secondaries much smaller, only occupying about two fifths instead of two thirds of the discoidal areole, the other white spots also smaller. Expanse of wings 99–108 millim.

One male. Near Assam.

In the Museum collection we have two females from Cachar. *P. Doubledayii* expands from 116 to 136 millim.

Hesperiidæ.

114. *Astictopterus diocles.*

Nisoniades diocles, Moore, P. Z. S. 1865, p. 787.

Near Assam.

Sphingidæ.

115. *Protoparce orientalis.*

Protoparce orientalis, Butler, Trans. Zool. Soc. vol. ix. p. 609, pl. xci. figs. 16, 17 (1876).

♂. Manipur.

Agaristidæ.

116. *Eusemia bellatrix.*

Eusemia bellatrix, Westwood, Cab. Orient. Ent. pl. xxxiii. fig. 2.

Near Assam.

Chalcosiidæ.

117. *Amesia aliris.*

Gynautocera aliris, Doubleday, Ann. & Mag. Nat. Hist. ser. 1, vol. xix. p. 74 (1847).

Manipur.

CALLAMESIA, gen. nov.

Allied to *Amesia*, but the primaries of a more triangular (*Euplœa*-like) form; the first subcostal branch running into the costal vein instead of running freely to the margin, both first and second branches emitted much further from the end of the cell, third and fourth branches forming a much narrower fork to apex; upper radial nearly straight instead of curved; lower radial emitted from the posterior angle of the cell instead of from the third median branch; submedian and internal veins united beyond the middle by a transverse veinlet*; secondaries much more oval than in *Amesia*, but with similar neuration. Antennæ pectinated in both sexes; palpi porrected; legs more slender than in *Amesia*; genitalia of males not covered by the great horny incised shield common to *Amesia*. Type *C. midama*.

118. *Callamesia midama.*

♂. *Epyrgis midama*, Herrich-Schäffer, Auss. Schmett. fig. 7.

♂. Near Assam.

119. *Erasmia pulchella.*

Erasmia pulchella, Hope, Trans. Linn. Soc. xviii. p. 446, pl. xxxi. fig. 5.

Near Assam.

Nyctemeridæ?

120. *Pterothysanus laticilia.*

Pterothysanus laticilia, Walker, Cat. Lep. Het. ii. p. 401 (1854).

Near Assam.

Herr Buchecker thinks that this genus should be placed (with its near ally *Caloschemia*) next to *Epicopeia*, on account of its having no internal vein to the secondaries; it, however, differs from *Epicopeia* in having four branches to the median vein in all the wings, a radial vein being emitted from the inferior angle of the cell in each instance; this is also the case with *Deilemera*, *Pitasila*, *Trypheromera*, *Leptosoma*, and other genera of Nyctemeridæ. Though it is impossible, without knowing the earlier stages of a genus like this, to come to any final decision as to its proper location, it appears to me that one character of venation should be of equal importance with another. In all probability the internal vein is merely aborted.

* This very aberrant character, pointed out to me by Herr Buchecker, first satisfied me that two genera were confounded under *Amesia*.

121. *Pterothysanus atratus*, sp. n. (Pl. VIII. fig. 3.)

Primaries above smoky brown; a large spot near the base of interno-median area; a second larger spot within the end of the cell, two small spots beyond the cell; two spots, well separated, beyond the middle of the costal border; an oblique subapical ;-shaped marking, a spot at outer third of second median interspace, and a large excised patch crossed by the first and second median branches, all white; a marginal series of irregular angular pink spots: secondaries white; base, costal margin, an irregular angulated band, widest at inner margin, crossing the wing before the middle, and the external third (the inner edge of which is acutely incised and undulated) smoky brown; five rather small submarginal white spots; a marginal series of irregular angular pink spots. Body orange-ochreous, spotted with black; venter black, with two parallel series of small white spots. Expanse of wings 74 millim.

Near Assam.

Apart from differences of pattern this species is readily separable from *P. laticilia* by the pink marginal spots, in which respect it shows some relationship to *P. pictus*.

Lasiocampidæ.

122. *Spalyria testacea.*

Dreata testacea, Walker, Cat. Lep. Het. iv. p. 906. n. 9 (1855).
Eupterote testacea, Butler, Ill. Typ. Lep. Het. v. p. 67, pl. xcvii. fig. 1 (1881).

Near Assam.

123. *Eupterote lucia*, sp. n. (Pl. VIII. fig. 4.)

♀. Nearest to *E. amœna* from Java; of about the size of the largest specimens of that species; of a more brilliant chrome-yellow colour; all the wings crossed by three central or nearly central purplish-brown lines, dentate-sinuate on the primaries and zigzag on the secondaries, the third line partly bounded externally by a nearly straight band of the same colour, followed at a short distance by a series of dots on the veins, which towards costa of primaries are united by an undulated brown line, forming the inner edge of three imperfect confluent rings, the lower two of which enclose brown spots; the outer edge of the rings commences as an ill-defined sinuated submarginal line; costa of primaries irrorated with brown towards apex; markings below less perfect, but widening towards costa of primaries, chocolate-coloured. Expanse of wings 95 millim.

Near Assam.

Readily distinguished from all females of *E. amœna* by the entire absence of the purplish-rufous undulated bands on the basal area, of the black spots across the disk, and of the marginal suffusion.

Euschemidæ.

124. *Euschema excubitor.*

Euschema excubitor, Moore, P. Z. S. 1878, p. 846.

Near Assam.

125. *Euschema militaris.*

Phalæna Attacus militaris, Linnæus, Syst. Nat. ii. p. 811. n. 12.

Near Assam.

Phyllodidæ.

126. *Lygniodes hypoleuca.*

Lygniodes hypoleuca, Guénée, Noct. iii. p. 125. n. 1500.

Near Assam.

Hypopyridæ.

127. *Spirama retorta.*

Phalæna-Noctua retorta, Cramer, Pap. Exot. ii. p. 29, pl. cxvi. F (1779).

♀. Near Assam.

Of the moths in this collection only one specimen of each species was captured.

EXPLANATION OF PLATE VIII.

Fig. 1. *Prothoë regalis.*
Fig. 2. *Terias heliophila.*
Fig. 3. *Pterothysanus atratus.*
Fig. 4. *Eupterote lucia.*

XXXII.—*Descriptions of Sponges from the Neighbourhood of Port Phillip Heads, South Australia, continued.* By H. J. Carter, F.R.S. &c.

[Continued from p. 294.]

Family 2. Axinellida.

Group 6. Multiformia.

We now come to the second family of the Echinonema, viz. the Axinellida, whose diagnosis, as above extended, would stand thus:—

"Echinated with proper spicules projecting from the *interior* of the fibre. Structure increasing in density *inwards*, or towards the first-formed parts, *i. e.* the axis." And applying the same remarks to this group as to the Pluriformia in the first family, I would observe, with reference to the sponges mentioned in the "key" to my Classification (*op. et l. cit.* p. 196), that the caulescent branched species termed by Schmidt "*Axinella verrucosa*" (Spongien Adriat. Meeres, Taf. vi. fig. 3), but of course without the parasitic polyp, might form the type of a group named "Axinellina," in which all the species of the genus "*Axinella*" that Schmidt has described (*op. cit.*) might be inserted, together with others from Mr. Wilson's collection, which will be mentioned hereafter, in most of which the branched caulescent characters being more marked will afford a still better typical illustration. Here also might be inserted *Dictyocylindrus rugosus*, Bk., and not "*hispidus*," as stated in the "key" to my Classification (*l. c.*), since the latter has a spinous club-shaped, echinating spicule and the former has *not* (see Bowerbank, Mon. Brit. Spong. vol. iii. pls. xvii. and xx. figs. 1,1, respectively); thus Schmidt has stated of *D. rugosus* that it has "das Ansehen von *Axinella cannabina*" (*op. cit.* II. Suppl. p. 15). The only difference between most of the arborescent Dictyocylindrina and the Axinellina is the presence of the echinating spicule in the former and its absence in the latter. Again, *Acanthella*, Sdt., might also come in here under a group named "Acanthellina," of which the finest specimen that I have seen is among Mr. Wilson's dried sponges from the south coast of Australia, presented to the British Museum through myself in 1884, now bearing the register no. "84. 10. 10. 2," and described at length in the 'Annals' of 1885 (vol. xv. p. 114); while *Halichondria ventilabrum*, Johnst., =*Phakellia ventilabrum*, Bk., of which I have described a branched form in the 'Annals' of 1883 (vol. xii. pp. 316 and 318) under the name of *P. ramosa*, might be relegated to a group called "Phakellina."

To these also might be added two other groups of more or less caulescent, branched, stipitate forms, with hirsute or ragged surfaces, under the names of "Phycopsina" and "Ptilocaulina," for the typical species respectively of *Phycopsis fruticulosa* and *Ptilocaulis gracilis*, described for this purpose in the 'Annals' of 1883 (vol. xii. pp. 319 and 321); if the former has not been based upon washed-out beach specimens, which I begin now to doubt, for one can never be certain of the original form of such contributions: also *massive* forms, under the generic name of "*Leucophlœus*" (*ib.* p. 323), of

which a group might be created under the name of "Leucophlœina"—each of which has been *advisedly* selected as respectively typical of some of the groups which it has appeared to me, after my experience with the specimens in the British Museum, to be most desirable to record at once, or as soon as I had the time. Doubtless there are many others, but *non possumus*.

Looking over my notes and sketches of Multiformia in the British Museum when my Classification was made (for I still possess the MS. volumes in which illustrated descriptions of all the species and most of the specimens in the collection were recorded), I find that by far the greater part are branched and stipitate, some flabelliform, a few vasiform, and still fewer massive. The branched forms, again, may be shrubby with the branches cylindrical, dichotomously divided, and smooth like those of *Axinella verrucosa*, in which they very much resemble a digitate *Chalina*; or they may be cylindrical and ragged, *i. e.* proliferously processed all round as in *Ptilocaulis gracilis*; or rough and shaggy as in *Phycopsis hirsuta*; or the caulescent branches may be compressed and arranged side by side flabelliformly, that is dichotomously dividing on the same plane, when, by interuniting and throwing out a thorny growth from the surface on both sides, with sarcode tympanizing the intervals, the Acanthelline form may be produced, or by growing together erect and laterally united into a group massively, they may assume the form of *Leucophlœus massalis*. But, as I have before stated, there appears to me to be no limit to the varieties of form which the sponges in *every* order may assume, and the *same* forms in *every* order which, so long as they were indiscriminately mixed together under the universal name "Spongia," as in Lamarck's 'Histoire Naturelle des Animaux sans Vertèbres,' was comparatively an easy matter; but since a minute examination of their structure and spiculation under the microscope has necessitated their separation by an almost individual nomenclature, that which was an "easy matter" under a universal term has become most perplexing. Hence, as one series of forms does for the whole class, I have given a tabulated view of these in the 'Annals' of 1875 (vol. xvi. p. 7, pl. iii.), to which I must refer the reader for further information on this subject.

As regards the last group of the Axinellidæ, viz. the Durissima, I can state no more than at the time I made it, which I did chiefly for such species as had a very rigid skeleton, in which the fibre was very thick and the dried sarcode hung about it, more or less tympanizing the interstices of the

reticulation like dry glue, scantily cored with thin acerate spicules, but denuded of everything else, apparently from long washing in the waves of the beach off which they had been gathered for preservation—characters which sufficed for my Catalogue of the specimens in the British Museum, but are of no practical utility for general purposes; hence, I cannot insist upon its being retained under any other circumstances. There were only three of these specimens, and unless future observation of them in an unmutilated and fresh state should justify their separation from the rest of the Multiformia, the group "Durissima" had better be abolished.

Fam. 3. **Pseudoechinonemida**, new fam.

Lastly, it becomes necessary to add this third family to the order ECHINONEMA for the Areniferous species, as pointed out under the head of "fam. Pseudohircinida" in 'Annals,' 1885, vol. xv. p. 319, where my reasons for so doing have been given at length, so I need not repeat them here. As an illustration of this family I will at once briefly state the characters of the fragment in my possession, to which allusion has already been made in the "*Obs.*" to *Echinoclathria favus*, before going to the species in Mr. Wilson's collection.

Echinoclathria favus, var. *arenifera*, n. var.

Fragment cylindrical, round at the free extremity, where there is a contracted, circular, cloacal aperture corresponding with the hollow interior; broken off at the other end. Identical in structure and spiculation with the species *Echinoclathria favus*. Consistence fragile, friable. Colour now, in its dry state, grey-brown, sand-like. Fibre cored with foreign objects in addition to its natural spiculation, together with arenaceous fibre *alone*; many more foreign objects adhering to the outside of the fibre than are situated in its interior. Size of fragment 10 in. long by about $\frac{3}{4}$ in. in diameter; cloacal canal about $\frac{3}{8}$ in. in diameter.

Hab. Marine.

Loc. Unknown. ? South coast of Australia.

Obs. This variety of *Echinoclathria favus* seems to have been occasioned by its having grown in the midst of sand, which, as just stated, seems to be much more plentiful in and around the outside of the fibre than in its interior.

Our Classification so far therefore would now stand thus:—

Order V. ECHINONEMA.

Families.	Groups.
1. *Ectyonida*	1. Pluriformia. *a.* Ectyonina. *b.* Echinonematina. *c.* Dictyocylindrina. 2. Plumohalichondrina. 3. Microcionina. 4. Echinoclathrina*. 5. Baculifera. 6. Higginsina (new group).
2. *Axinellida*	7. Multiformia. *a.* Axinellina. *b.* Phakellina. *c.* Acanthellina. *d.* Phycopsina. *e.* Ptilocaulina. *f.* Leucophlœina.
3. *Pseudoechinonemida* (new family).	*a.* Echinonematina arenacea. *b.* Plumohalichondrina arenacea.

Having premised the revision of my Order V., viz. ECHINONEMA, which time and experience up to now show to me to be desirable, I will describe the sponges which Mr. Wilson has kindly sent to me, under the groups to which they seem respectively to belong, briefly, it is true, but sufficiently for our present purpose. In this description it should be understood that we are concerned now with these specimens alone, and therefore that, where there are no representatives of any of the groups mentioned in the Table last given (as, for instance, the Ectyonina or Ectyones), this must be inferred, as it will not be further noticed.

As all the specimens come from the sea in the neighbourhood of "Port Phillip Heads," Victoria colony, south coast of Australia, the "depth" alone will be inserted. Again, the granulations on the surface, which are respectively composed of tufts of the spicules of the species that thus terminate the ends of the fibre and are often hispid, frequently serve to distinguish the ECHINONEMA from the RHAPHIDONEMA, which, on the other hand, from their spicules being for the most part confined to the fibre, do not present this echinated appearance. The pores, too, which are situated in the dermal membrane between the "tufts," are often unnoticed because not often seen, although they may always be inferred to exist in the position mentioned.

All the measurements of the spicules are given in 6000ths

* Echinoclathrata has been changed to Echinoclathrina for uniformity only.

of an inch (the value of that division of my micrometer-eye-piece) for comparison, and they are intended to represent the greatest dimensions longitudinally and transversely of the average largest kinds approximately, as they very often vary in this respect, not only in different specimens but in different parts of the *same* specimen. When spined or differently formed from the common type of both acerates and acuates, this will be mentioned.

Fam. 1. **Ectyonida.**

Group 1 *b*. Echinonematina.

1. *Echinonema flabelliformis.*

Stipitate flabelliform, like a clam-shell in general shape, moderately thin, stem short. Consistence firm. Colour, when fresh, "pale terra cotta," now brown. Surface even, smooth, consisting of a minutely reticulated dermis spread over a reticulated, cancellous, fibrous structure beneath. Pores in the interstices of the reticulation. Vents in the margin corresponding to the terminations of branched, radiating, linear depressions on the surface, which originate towards the stem. Spicules of three forms, viz.:—1, skeletal, acuate, 55 by 1-6000th in.; 2, echinating, clavate, spined throughout, 12 by 1-6000th in. including the spines; 3, a small acuate in tufts confined to the surface, 25 by $\frac{3}{4}$-6000th in. Structure uniformly compact throughout, hardening generally towards the stem, but not axially in any part. Size of specimen $6 \times 6 \times \frac{1}{2}$ in.

Depth 19 fath.

2. *Echinonema cæspitosa.*

Massive, sessile, spreading, with irregular proliferous cauliflower surface; proliferous portions rising above the common level into most irregular and jagged processes, great and small, of variable size. Consistence firm, resilient. Colour, when fresh, "brick-red," now sponge-colour. Surface uniformly granulated, supporting a smooth dermis. Vents on the lobular projections. Spicules of three forms, viz.:—1, skeletal, acerate, cylindrical, nearly straight, almost immeasurably thin, chiefly confined to the fibre, 45-6000ths long; 2, echinating, acuate, spined throughout, 20-6000ths long; 3, flesh-spicule equianchorate, naviculiform, bent upon itself, $3\frac{1}{2}$-6000ths in. long. Structure columnar, compact, radiating upwards. Size of specimen, $1\frac{1}{2}$ in. high by 5×4 in. horizontally.

Depth 19 fath.

3. *Echinonema pectiniformis.*

Flabelliform, circular, stipitate; margin almost even; stem short; proliferous processes at the base. Consistence hard, compact. Colour, when fresh, "pale terra-cotta red;" now the same internally, but dermis pale brown. Surface even, here and there presenting small elevations. Vents on the elevations, also indicated although not actually seen, on the margin, by branched depressions marking the course of subjacent excretory canals running towards it. Spicules of two forms, viz.:—1, skeletal, acuate, 60 by 1-6000th; 2, echinating, clavate, spined throughout, 9 by 1-6000th. Structure uniformly compact. Ovigerous. Size of specimen 8 by 7 in., thickness $\frac{1}{4}$ in.

Depth 20 fath.

Obs. This and *E. flabelliformis* appear to be the same species.

4. *Echinonema incrustans.*

Massive, incrusting, thick, covering the whole of a *Pecten*. Consistence firm, resilient. Colour, when fresh, "brick-red," now rich orange. Surface uniformly granulated. Pores not seen. Vents numerous, large, scattered over the surface. Spicules of three forms, viz.:—1, skeletal, slightly fusiform, abruptly pointed, chiefly in the fibre, 105 by $1\frac{1}{2}$-6000th; 2, echinating, acuate, clavate, spined throughout, 18-6000ths long; 3, flesh-spicule, equianchorate, naviculiform, 4-6000ths long. Structure compact, sarcode orange-yellow. Size of specimen $2 \times 3\frac{1}{2}$ in., $\frac{3}{4}$ in. thick.

Depth 11 fath.

Group 1 *c*. DICTYOCYLINDRINA.

5. *Dictyocylindrus pinnatifidus.*

Stipitate, compressed, bunch of cylindrical stalks of various lengths, often divided polychotomously as well as dichotomously, terminating in long and short lengths and in sharp points which are sometimes bifid, proliferously plumose or pinnate in two lines opposite each other, feather-like, for some distance up the branch. Consistence soft, hirsute or velvety on the surface. Colour, when fresh, "dark brown," the same now. Surface uniformly granulated, hispid, the latter more particularly where the dermis has been abraded. Pores and vents not conspicuous. Spicules of three forms, viz.:—1, skeletal, long, setaceous, acuate, 255 by 3-6000ths; 2, subskeletal, acuate, smooth, averaging 75-6000ths long;

3, echinating, acuate, clavate, spined throughout, 17-6000ths long. All congregated together and when projecting from the superficial ends of the fibre producing the granulations and hirsute character of the surface. No. 2, in great abundance, separate or together leaf-like, round the lower part of no. 1. Structure soft and hirsute on the surface, hard towards the axis, very like *Axinella setacea* (p. 359), which, but for the absence of the echinating spicule (which, however, is often so scarce in this kind of sponges as to pass unnoticed without prolonged examination), would have been placed in the group Dictyocylindrina. Size of specimen 12 in. long.

Depth 5 fath.

Obs. By "compressed" is meant more or less in the same plane.

6. *Dictyocylindrus cacticutis.*

Stipitate, somewhat compressed head of branches interunited after the first division into irregular compressed lobes, proliferously covered with radiating, ragged, thorn-like ridges and points. Consistence soft on the surface, harder towards the axis. Colour, when fresh, "black," now black-brown. Surface scattered over with thorn-like elevations, cactus-like, covered by a smooth dermis. Vents chiefly on the margins of the compressed lobes. Spicules of two forms, viz.:—1, skeletal, subpinlike, curved, smooth, 65 by 2^{1}-6000ths, chiefly confined to the fibre; 2, echinating, acuate, spined, 25 by 3-6000ths, including the spines. Structure compact, chiefly towards the axis, but not distinctly hard in the centre. Size of specimen $3 \times 3 \times 3$ in. including the stem, which is short and thick.

Depth 19 fath.

7. *Dictyocylindrus piniformis.*

Stipitate, massive head of proliferous lobes; lobes compressed, thick, expanded, united together in the centre; irregularly and reticulately nodose over the surface and margins. Consistence resilient externally, becoming dense towards the axis. Colour, when fresh, "drab," now sponge-drab. Pores and vents not conspicuous. Spicules of three forms, viz.:—1, skeletal, acerate, curved, smooth; 2, also skeletal, but *acuate*, curved, and smooth, both about the same size, viz. 35 by $\frac{1}{2}$-6000th; 3, echinating, acuate, clavate, spined throughout, 12-6000ths long. Structure compact externally, becoming denser towards the axis. Size of specimen 5 in. high including the stem, head 3×3 in. horizontally.

Depth not stated.

Group 2. PLUMOHALICHONDRINA.

8. *Plumohalichondria mammillata.*

Massive, sessile, with mammilliform erect lobes. Consistence soft, resilient when wet, hard when dry. Colour, when fresh, "venetian red," the same now inside, but paling towards the dermis. Surface even, uniformly but largely granulated; dermis reticulated over the granulations or elevated parts. Vents large, scattered irregularly over the mass, none at the ends of the mammilliform lobes. Spicules of four forms, viz.:—1, skeletal, acuate, curved, spined generally, about 35 by 1-6000th; 2, the "tibiella," acerate, almost straight, slightly fusiform and abruptly pointed, about 44 by $\frac{2}{3}$-6000th; 3, echinating, smaller, acuate, spined all over, 12-6000ths long; 4, flesh-spicule, equianchorate, angulate, $4\frac{1}{2}$-6000ths long. The tibiella is chiefly confined to the axis of the fibre. Nos. 1 and 3 echinating, and no. 4 confined to the sarcode. Structure open resilient, soft generally, no axial condensation. Size of specimen 5 in. high, 6 × 3 in. horizontally.

Depth 3 fath.

Obs. Very like the British species, viz. *Plumohalichondria plumosa*=*Hymeniacidon plumosa*, Bk. (Mon. Brit. Spong. vol. ii. p. 195), and *Microciona plumosa*, Bk. (*ib.* vol. iii. pl. xxiv. fig. 7, &c.), but different from the Cape species, wherein the large spinous acuate is mixed up with the tibiella in the axis of the fibre. The Cape species, which might be termed "*P. capensis*," is the finest of all that I have seen, and as yet has been undescribed, although it appears to be as abundant as it is remarkably fine. There are many specimens of it in the British Museum from Port Elizabeth, especially those bearing my running no. 74, registered 71. 5. 12. 1, &c.

Group 4. ECHINOCLATHRINA.

9. *Echinoclathria tenuis.*

Stipitate, compressed, very thin and leaf-like, lobed all on one side of the stem, like a one-sided lobed leaf; lobes irregularly denticulated on the margin. Consistence firm. Colour, when fresh, "venetian red," now brown. Surface minutely and uniformly granulated. Spicules of three forms, viz.:—1, skeletal, subpinlike, fusiform, curved, smooth, 45 by $1\frac{1}{2}$-6000th, chiefly confined to the fibre; 2, subskeletal, also subpinlike, very fine, thin, and long, 20 by $\frac{3}{4}$-6000th, tending

by its projection to give the surface a hispid or villous character; 3, echinating, also subpinlike, but *smooth*. Structure rather open and reticulated on the surface, becoming more compact towards the centre of the lamina. Size of specimen 7×7 in. and $\frac{1}{8}$ in. thick.

Depth 20 fath.

10. *Echinoclathria nodosa.*

Stipitate, caulescent, branching, small specimen growing on and over an Ascidian; branches nodulated, interuniting. Consistence soft, resilient. Colour, when fresh, not mentioned, now brown sponge-colour. Surface of branches irregularly nodose, uniformly granulated over all. Vents in the sulci between the nodulations. Spicules of two forms, viz.:—1, skeletal, acuate, smooth, 35 by 1-6000th; 2, echinating, also acuate and smooth, 25 by $1\frac{1}{2}$-6000th; the former confined to the interior, the latter chiefly to the granulations on the surface. Structure very compact throughout, but not axially condensed or hardened. Size of specimen $3\frac{1}{2}$ in. high by 3×2 in. horizontally.

Depth 5 fath.

11. *Echinoclathria subhispida.*

Stipitate, compressed bunch of stalks with short stem; stalks cylindrical at first, then dividing at short distances dichotomously and polychotomously, finally terminating in flat, expanded, round ends more or less bifid. Consistence firm. Colour, when fresh, "venetian red," now rich brown. Surface uniformly granulated, subhispid. Pores and vents not seen. Spicules of two forms, viz.:—1, skeletal, acuate, smooth, 30 by $1\frac{1}{4}$-6000th, chiefly confined to the fibre; 2, echinating, also acuate, smooth, small, thin, about 20-6000ths long. Structure consisting of short-jointed tough fibre more or less compact, becoming denser towards the axis. Size of specimen 5 in. high by $5 \times \frac{1}{2}$ horizontally.

Depth 11 fath.

12. *Echinoclathria gracilis.*

Stipitate, caulescent, branches long, very slender, irregularly cylindrical, about $\frac{1}{8}$ in. in diameter, dichotomously and polychotomously divided near the stem, afterwards ending in long stalks terminating in round ends. Consistence hard. Colour, when fresh, "dark red," now dark brown. Surface even, minutely granulated. Vents apparently few and scattered. Spicules of two forms, viz.:—1, skeletal, acuate, smooth, comparatively small, 25 by 1-6000th; 2, echinating, small, acuate, fusiform, with slightly and terminally spined

head, 17 by 1-6000th. Structure hard, compact, firm throughout, not condensed axially. Size of specimen 6 in. long.
Depth 20 fath.

Group 6. HIGGINSINA (new group).

13. *Trachycladus lævispirulifer*, Carter ('Annals,' 1879, vol. iii. p. 343, pl. xxviii. fig. 1).

Obs. There are two specimens of this sponge whose cylindrical branches dichotomously divided only once or twice are 12 in. long by $\frac{2}{8}$ in. in diameter, diminishing towards the points. They are chiefly remarkable for their bright colour, said, when fresh, to be "brilliant scarlet," now but little faded. This colour is owing to the presence of an apparently ? symbiotic oscillatorian Alga, varying under 4-6000ths in. long, and in its largest form consisting of four cells, of which the terminal one at one end is conical or pointed. It is so abundantly present and so much larger than the flesh-spicules, which are again very small, that without close examination the latter are apt to pass unnoticed.
Depth 19 fath.

Obs. It is a short oscillatorian Alga which gives the red and other bright colours to the Red Sea; also the cærulean cobalt tint to the cærulean Suberitic sponge of this coast; and sometimes living symbiotically with *Spongelia pallescens*, where Dr. F. E. Schulze has actually found it to be present in plurality in the ciliated *embryo* (Zeitschrift f. wiss. Zool. Bd. xxxii. Taf. v. fig. 7), of which he kindly sent me a preparation.

14. *Higginsia coralloides*, Higgin ('Annals,' 1877, vol. xix. pl. xiv. fig. 1, &c.).

Obs. Of this species there are two or three specimens, with a variety, which may be described as follows:—

15. *Higginsia coralloides*, var. *massalis*.

Sessile, massive, lobate, contracted towards the base, convex above. Consistence firm, resilient. Colour, when fresh, "dull purple," now light mouse-colour. Surface uniformly covered with meandering sulci separating correspondingly, formed round linear elevations or ridges supporting a smooth dermis. Vents small, very numerous, following the meandering lines of the sulci between the ridges. Spiculation like that of *Higginsia coralloides*, only here and there the acerate is acuated.

Obs. All the specimens of *Higginsia* come from about the same place or depth, viz. 11 fath., and all are stated to have

been of a "dull purple" colour when fresh. The occurrence of the *acuates* in the variety "*massalis*" causes it to resemble in spiculation *H. natalensis*, before described, of which the type is in the British Museum.

16. *Higginsia lunata* (provisional).

Sessile, globular, massive, with a small mammilliform process-growth over the surface. Consistence soft. Colour, when fresh, "dark slate," which is the colour of the surface now, but interiorly sponge-colour. Surface smooth, uniformly covering the small processes, which are conulated and accompanied by an unusually thick, firm, reticulated dermis in the intervals. Vents large, scattered over the surface. Spicules of three forms, viz.:—1, skeletal, acerate, smooth, curved; and 2, also skeletal, but acuate, smooth, curved, both about the same size with gradationary forms between them; all about 120 by 2-6000ths; 3, flesh-spicule, acerate, much curved, often to a lunate form, microspined, often in groups parallel to each other, simulating the development of a tricurvate, about 9 by $\frac{1}{3}$-6000th; the former chiefly confined to the fibre, the latter to the sarcode. Size of specimen 1 in. high by 3×3 horizontally.

Depth 19 fath.

Obs. The thick slate-coloured dermal layer is very characteristic of this species, and its spiculation comes nearest to *Higginsia*, unless the microspined flesh-spicule should be nothing but a spined tricurvate, when the resemblance would be so much less that for the present I can only consider its "seat" as undetermined.

Fam. 2. **Axinellida.**

Group 7 *a*. AXINELLINA.

17. *Axinella chalinoides.*

Stipitate, caulescent, dichotomous, cylindrical, branches of different lengths, rather compressed, slightly diminishing in size from the stem, which is short and thick, to the extremities, which are round. Consistence firm, resilient. Colour, when fresh, "dull brick-red," now brown. Surface uniformly but minutely granulated, and minutely hispid, often rendered rather uneven by the presence of subjacent excretory canals. Vents on the branches in two rows opposite to each other, often accompanied by stelliform radiation, owing to the presence of subjacent but superficial excretory canals. Spicules of one form only, viz. a small, smooth, acuate, about 20 by

1-6000th, in the fibre, and forming tufts (the granulations) on the surface. Structure tough, dense, and compact. Size of specimen 10 in. long, branches about $\frac{3}{8}$ in. thick.

Depth 19 fath.

Obs. The subhispid character of the surface, the stelliform venation around the vents formed by collapse of the dermal sarcode over the subjacent excretory canals, and the compact dense structure of the tissue generally, at once points out the difference between this sponge and a caulescent-branched *Chalina.*

18. *Axinella chalinoides*, var. *glutinosa.*

Stipitate, caulescent, cylindrical, branched, the latter chiefly divided towards the terminations, which are comparatively short and pointed. Consistence soft on the surface, dense towards the axis. Colour, when fresh, "chocolate," now brownish mouse-colour. Surface smooth, even, hispid where the dark glutinous sarcode of the exterior has sunk down upon the long acerate spicules during desiccation. Vents chiefly in two lines opposite to each other on the cylindrical stalks. Spicule of one form only, viz. acuate, but of different sizes, the largest and longest 135 by 2·6000ths. Structure loose, soft, and gelatinous on the surface from the thickness of the dermis, becoming dense and hard towards the axis. Size of specimen 8 in. long, larger branches about $\frac{1}{2}$ in. in diameter.

Depth 20 fath.

19. *Axinella setacea.*

Stipitate, much compressed bunch of numerous branches, radiating dichotomously and polychotomously from a short stem; branches cylindrical, terminating in sharp points, simple and bifid at the ends respectively. Consistence soft, resilient. Colour, when fresh, "dark yellowish brown," now dark brown. Surface granular, hispid. Vents not seen. Spicules of one form only, viz. acuate, curved, smooth, of different sizes, chiefly confined to the fibre, in and projecting through it; the largest and longest which gives the setaceous character 210 by $4\frac{1}{2}$-6000ths; another set but much smaller and shorter, gathered together sheaf-like round the base of the long setaceous one from the granulations on the surface. Structure rather loose and soft externally, becoming compact towards the axis. Size of specimen $4\frac{1}{2}$ in. high by $4\frac{1}{2} \times \frac{1}{2}$ in. horizontally.

Depth 7 fath.

20. *Axinella atropurpurea.*

Stipitate, somewhat compressed bunch of dichotomously

and polychotomously divided cylindrical branches, more or less interunited clathrously, terminating elkhorn-like or polychotomously, with obtuse rounded ends. Stem short and thick. Consistence soft on the surface, hard in the axis. Colour when fresh "dark purple," the same now, as this is one of the few species which retain their colour, for it has now been in spirit for upwards of a year and a half without being the least altered in this respect, which may be owing to the colouring-matter being contained in rather *tough* transparent cells, where it exists in the form of several large black-purple granules. Surface even, granulated, with granular tufts of spicules. Vents small, here and there on the surface. Spicules of one form only, viz. acuate, sub-pinlike, or slightly inflated at the base, but of different sizes, the longest and largest 300 by $7\frac{1}{2}$-6000ths, around which, towards the proximal end, a number of others of the same shape are gathered sheaf-like, varying under 90 by $1\frac{1}{2}$-6000ths. Structure soft on the surface, hard towards the axis. Size of largest specimen, for there are three of this beautiful sponge, $2\frac{1}{2}$ in. high, including the stem, by $3\frac{1}{2} \times 1\frac{1}{2}$ in. horizontally.

Depth 19 fath.

21. *Axinella stelliderma.*

Stipitate, compressed bunch of dichotomously and polychotomously divided cylindrical branches, more or less amalgamating and interuniting on their way to the terminations, which are conical and pointed singly or bifidly. Consistence soft, resilient. Colour when fresh "purplish maroon," yellowish white now. Surface even, granulated, granules smooth and round on the summit, stellately radiating towards each other in reticulated lines of the fibrous dermis which are thus arranged. Vents not seen. Spicules of one form only, viz. acuate of different sizes, the longest and largest about 180 by 2-6000ths, projecting from the summit of the granule and surrounded at its base sheaf-like by a number of shorter ones. Differing from the following variety, viz. *Axinella stelliderma*, var. *acerata*, only in the form of the spicule, which is acuate instead of acerate. Structure soft on the surface, hard and compact towards the axis. Size of the largest specimen, for there are two, 7 in. high by $7 \times \frac{1}{2}$ horizontally.

Depth 10 fath.

22. *Axinella stelliderma*, var. *acerata.*

Stipitate, compressed bunch of short, thick, cylindrical, dichotomously and polychotomously divided branches, more

or less interuniting and amalgamated; simple or bifid at the ends, which are conical. Consistence soft, resilient. Colour when fresh "dull purple," now yellowish white, opaque. Surface even, largely granulated; granules smooth, radiating star-like, the rays being part of the dermis, interuniting with each other reticulately between the granules. Vents not seen. Spicule of one form only, viz. acerate, fusiform, smooth, finely pointed, 75 by 1-6000th. Structure soft on the surface, becoming compact and hard towards the axis. Size of specimen $3\frac{1}{2}$ in. high by $4 \times 1\frac{1}{2}$ in. horizontally.

Depth 20 fath.

23. *Axinella villosa* (dry specimen).

Stipitate bunch of caulescent dichotomous branches, rising from a short, thick, round stem, spread out at the base for attachment; branches cylindrical, dividing near the stem, diminishing in size towards the extremities, which are bifid and pointed. Consistence soft on the surface, hard in the axis. Colour when fresh not stated, now brown-grey. Surface now, in its dried state, roughly reticulated and shaggy, from the subsidence of the sarcode between the subjacent spiculiferous tissue, which thus appears clotted together like that of *Dictyocylindrus rugosa*, Bk. Spicules of one form only, viz. acerate, curved, smooth, about 78 by $2\frac{1}{2}$-6000ths. Structure loose on the surface, becoming condensed and hard towards the axis. Specimen 7 in. high by 3×3 in. horizontally; branches about $\frac{2}{8}$ in. in diameter.

Depth not stated.

The above species being branched and caulescent are very much like those of the group Dictyocylindrina, differing only, as before stated, in the absence of the echinating spicule.

24. *Axinella flabellata.*

Stipitate, compressed expanded, thickish, lobate; margin irregular; stem short, angular and thick. Consistence firm, resilient. Colour when fresh "brown-grey," now dark sponge-colour. Surface even, minutely granulated. Vents not seen. Spicules of three forms, viz.:—1, skeletal, acuate, 70 by 2-6000ths, chiefly confined to and projecting through the fibre; 2, "trichites," loose and in sheaf-like bundles, about 12-6000ths long; 3, flesh-spicule, bihamate, C- and S-shaped, simple and contort, 4-6000ths long, both the latter abundant and confined to the sarcode. Structure compact, becoming more condensed and hard towards the axis. Size of specimen $3\frac{1}{2}$ in. high by $4\frac{1}{2} \times 1\frac{1}{2}$ in. horizontally.

Depth 18 fath.

Obs. This specimen has a piece of *Darwinella australiensis* about an inch in diameter growing upon its flat surface.

25. *Axinella pilifera.*

Massive, lobed, contracted towards the base, lobes more or less compressed. Consistence soft. Colour when fresh "orange-brown," now light brown. Surface covered with conuli, from the summit of each of which projects a coarse single filament of the fibre charged with the spicules of the species, giving the whole a hairy appearance. Vents small, scattered here and there over the lobes. Spicules of one form only, viz. acerate, 65 by 2-6000ths, chiefly confined to and projecting through the fibre. Structure rather loose generally. Specimen 3 in. high by $3\frac{1}{2} \times 1\frac{1}{4}$ in. horizontally.

Depth 20 fath.

26. *Axinella meloniformis.*

Massive, globular, sessile, ridged meridionally like a melon, with a depression on the summit. Consistence firm. Colour when fresh "orange," now pale yellow. Surface uniformly granulated, covered by a smooth dermis. Spicule of one form only, viz. acerate, 150 by 4-6000ths. Structure compact, hard, rough. Presenting immediately under the dermis a layer of large ? epithelial, nucleated, and granuliferous cells, chiefly elliptical in form, and about 10-6000ths in the longest diameter, accompanied by a layer of much smaller ones *in* the dermis, ? the *real* epithelial cells. Size of specimen $1 \times 1 \times 1$ in.

Depth 11 fath.

Obs. The presence of these large circular and elliptical nucleated and granuliferous cells, such as are found in several sponges (ex. gr. *Dercitus niger*, &c., 'Annals,' 1871, vol. vii. pl. iv. fig. 6, &c.), also in the Australian "new species" of Luffarida (? *Dendrilla rosea*, Lendenfeld) to which I have alluded as probably a new species in the 'Annals' of 1885, vol. xv. p. 202, &c., is interesting because they are *underneath* the fibrous dermis which is covered on the immediate surface with much smaller, ? the real epithelial cells, while the larger ones can hardly be considered to be ova, as they are confined to the position mentioned. They are pigment-cells in *Dercitus niger.*

27. *Axinella solida.*

Sessile, spreading, thick, cork-like mass. Consistence soft. Colour when fresh "orange," now sponge-colour. Surface undulating, cauliflower-like, consisting of short pointed granu-

lations. Pores and vents not seen. Spicules of one form only, viz. acuate, about 100 by 3-6000ths, situated in the interior of and projecting through the fibre. Structure columnar, composed of erect plumosely-tufted filaments in juxtaposition, ending in the granulations of the surface. Size of specimen $\frac{1}{2}$ in. high by 2×2 in. horizontally.

Depth 11 fath.

Group 7 *b*. PHAKELLINA.

28. *Phakellia flabellata.*

Substipitate, contracted towards the base, expanding into a flabellate form with irregularly undulating round border. Consistence resilient. Colour when fresh "yellow-buff," much the same now. Surface undulating, uniformly granulated. Pores and vents not conspicuous. Spicules of two forms, viz. one acuate, the other acerate, both about the same size, viz. 40 by $1\frac{1}{2}$-6000ths, chiefly confined to the fibre, which, ending on the surface in spiculiferous tufts, produces the granulated character. Structure compact, hardening towards the central plane, from which the fibre curves upwards and outwards to the surface on each side. Size of specimen 2 in high by $4 \times \frac{1}{8}$ in. horizontally.

Depth 20 fath.

29. *Phakellia crassa.*

Stipitate, flabellate, winged proliferously, thickish; margin round, irregularly undulating. Consistence firm, resilient. Colour when fresh "wax-yellow," now yellowish brown. Surface uniformly covered with papillary elevations about 4-12ths inch apart, supporting a granulated dermis. Vents small, stelliform, on the summits of the papillary elevations. Spicules of one form only, viz. acuate, small, stout, about 60 by $2\frac{1}{2}$-6000ths. Structure plumose, fibre curving upwards and outwards from the central plane, where it is condensed, to the surface on each side, where it is loose, and ends in tufts of spicules which form the granules. Size of specimen 6 in. high by 5 in. horizontally; lamina 5-12ths in. thick.

Depth 20 fath.

30. *Phakellia brassicata.*

Stipitate, vase-like rosette head, dividing at once from a longish stem into several short, somewhat compressed flabellate branches, which expand into still more compressed, thin, leaf-like divisions, about 1-8th in. thick; alate, proliferous, and

wavy, interunited with each other, tending to a foliate arrangement, but well separated, terminating in denticulated margins. Consistence hard. Colour when fresh "orange-red," now brown. Surface smooth, with a finely reticulated dermis, supported on short hispid fibre. Spicules of one form only, viz. acerate, 60 by $1\frac{1}{2}$-6000ths. Structure loose on the surface, hardening towards the axis. Size of specimen $5\frac{1}{2}$ in. high, including the stem, which is $2\frac{1}{2}$ in. long, $4\frac{1}{2} \times 3\frac{1}{2}$ horizontally across the brim.

Depth 19 fath.

Group 7 *c*. ACANTHELLINA.

31. *Acanthella cactiformis*, Cart. ('Annals,' 1885, vol. xv. p. 114, pl. iv. fig. 6).

Obs. Of this there are two specimens, viz. one dry, that to which I have alluded, and the other wet, which is much smaller and of which the depth was 19 fath.

32. *Acanthella hirciniopsis.*

Flabellate, with denticulated border and thorn-like irregularly conulated surfaces. Consistence soft outside, covering an extremely dense and compact massive skeletal frame. Colour when fresh "venetian red," now mouse-colour. Surface most irregular in growth, especially on one side, covered with prominent conuli, most irregularly distanced; each conulus smooth over the point where it is covered with a beautifully reticulated dermis, which, descending to the interconular spaces in a radiating form, becomes continuous with that of its neighbours, very much like that of a *Hircinia*. Epithelial cells, if any, very small, inconspicuous. Pores in the interstices of the dermal reticulation. Vents here and there, chiefly on the border. Spicules of one form only, viz. long, acerate, of various sizes under 110 by $1\frac{1}{2}$-6000ths. Structure of the dermal reticulation soft, composed of fusiform fibrillæ, *without* foreign substances; epithelial cells small and inconspicuous. Structure of the interior soft towards the surface, becoming densely compact towards the centre, which, when a portion is macerated, comes forth as a fenestrated skeleton composed of an intensely tough hard condensation of horny sarcode and the spicules of the species amassed together. Size of specimen, which is only part of the original, from which it has been cut off, 6 in. high by $4\frac{1}{2} \times 1$ in. horizontally.

Depth 19 fath.

Obs. There are two specimens of this sponge, both of which appear to have been cut off from much larger specimens, too large probably in their entirety to be put into the opening of the tin case in which they were sent, so that my description has been taken from that which appears to afford the most characteristic features; the other is much larger and more ragged, that is irregularly grown over on the surface, which thus in some places gives it a thickness of 3 inches. Its colour when fresh is stated to be "buff-brown, with tints of red." The conuli where uniformly distributed are 2-12ths in. apart, but where irregularly scattered sometimes 5-12ths in. apart, with great prominence and depth between them, which, being filled up by the dermal reticulated fibrous structure, at first sight, as before stated, gives them very much the aspect of a sponge belonging to the conulated Hircinida or Aplysinida, excepting that there are *no* foreign substances in the fibre and very small epithelial cells in the dermis. Depth of both specimens 19 fath.

33. *Acanthellina parviconulata.*

Sessile, erect, tall, lobate, fenestrated, more or less regularly covered with short thorn-like conuli. Consistence soft on the surface, dense in the interior. Colour when fresh "grey, tinged with terra-cotta red," now grey only. Surface extremely irregular and jagged from the presence of proliferous growths, covered with short thorn-like conuli supporting a fibro-reticulated dermis which conceals their points, thus rendering them round, and fills up the depressed intervals between them, very much like that of a *Hircinia*, only the conuli are much smaller and more numerous than in the foregoing specimen; hence the designation "*parviconulata.*" Vents numerous and large, especially over one of the erect lobes. Spicules of two forms, but very much alike in size, viz. one acuate and the other acerate, the latter abruptly pointed, each averaging about 60 by 2 to 3-6000ths. Structure soft on the surface, where the dermis, although of finer texture, is otherwise the same as that described under *Acanthella hircinopsis*, covering the same kind of densely-packed spiculiferous white skeletal framework. Size of specimen 6 in. high by $2 \times 1\frac{1}{2}$ in. horizontally.
Depth 18 fath.

34. *Acanthellina rugolineata.*

Somewhat compressed, massive, sessile, contracted towards the base, furrowed and correspondingly ridged with rough linear elevations. Consistence extremely soft. Colour when

fresh not stated, now light whitish yellow. Surface cactiform, covered by a reticulated dermis. Pores in the interstices of the dermal fibro-reticulation. Vents here and there along the upper part. Spicules of two forms, viz. acuate and acerate, both about the same size, viz. 80 by $2\frac{1}{2}$-6000ths, and both merging into each other by gradational variation, chiefly confined to the interior of the fibre and projecting through it. Structure soft on the surface, condensed to hardness internally, thus forming a solid skeletal mass of spicules and sarcode like that of the foregoing species. When dry the dermal structure, by its dark brown translucent gluey appearance and nature, contrasts strongly with the opaque white skeletal fabric beneath, as in *A. cactiformis*. Size of specimen about $2 \times 2 \times 2$ in.

Depth not stated.

Group 7 *f.* LEUCOPHLŒINA.

35. *Ciocalypta penicillus*, Bk. (Mon. B. S. vol. iii. pl. xiii. fig. 2, &c.), var. *aciculata*.

Obs. The only difference between this and Dr. Bowerbank's specimen is that the spicule is sub-pinlike, with fusiform shaft, instead of simply acuate. Depth 9 fath.

36. *Ciocalypta Tyleri*, Bk. (Proc. Zool. Soc. 1873, pl. iv. fig. 9).

Obs. Of this there are two specimens, depth 19 and 11 fath. respectively.

37. *Leucophlœa massalis*, Cart. ('Annals,' 1883, vol. xii. p. 323, pl. xiv. fig. 15).

Depth 19 fath.

Fam. 3. **Pseudoechinonemida.**

ECHINONEMATINA ARENACEA.

38. *Wilsonella australiensis*.

Flabelliform, stipitate, wavy, undulating in lines radiating from the base to the circumference; stem short. Consistence firm, resilient. Colour when fresh "white," much the same now. Surface areniferous, scattered over uniformly with papillary elevations about 5-12ths in. apart, on the summit of each of which is a large vent defined by a circular thin mar-

gin. Spiculation that of *Echinonema anchoratum* ('Annals,' 1881, vol. vii. p. 379), viz.:—1, smooth acuate, 25 by $\frac{2}{3}$-6000ths, chiefly confined to the centre of the fibre, with grains of sand and foreign objects; 2, echinating spicule, a spiniferous acuate, 16 by 1-6000th; 3, flesh-spicule a naviculiform equianchorate confined to the sarcode, $3\frac{1}{2}$-6000ths. Structure compact throughout, without axial or central condensation. Size of specimen, which is wet, 7 in. high by $7 \times \frac{1}{2}$ in. horizontally.

Depth 6 fath.

Obs. There is also a dry specimen of this species 10 in. high by 9×5 in. horizontally, composed of a large group of flabelliform plicated lobes of different sizes below the single one above mentioned, more or less proliferous and twisted in form, some of which are anything but like the typical one above described, yet all evidently modifications of the same plan, rising and spreading into a great group florally from a contracted subsessile base, about $2\frac{1}{2}$ in. in diameter.

It is this specimen which I have briefly described in the 'Annals' of 1885 (vol. xv. p. 320) under the above name, and of which there are several others of a like kind in the British Museum, all of which come from the south coast of Australia, and bear my running no. "128." As sponges on being dried generally shrink up to half their natural size, the dried one just mentioned must originally have been twice that above stated, so that when fresh it must have been a still more magnificent specimen than it is at present. The genus has been named after Mr. J. Bracebridge Wilson, M.A., F.L.S., of the Church of England Grammar School, Geelong, Victoria colony, South Australia, to whom, as before stated, I am indebted for all these sponges, both wet and dried.

Plumohalichondrina Arenacea.

39. *Plumohalichondria arenacea.*

Irregularly club-shaped, sessile, massive, lobed, tall, high, enclosing shells and sand at the base, which is contracted. Consistence tough, firm, resilient. Colour when fresh not mentioned, now pale yellow throughout. Surface uniformly granulated, covered by a minutely reticulated dermis. Vents rather small, scattered over the surface generally. Spicules of three forms, viz.:—1, skeletal acerate (the tibiella) nearly straight, 40 by $1\frac{1}{2}$-6000ths, chiefly confined to the centre of the fibre, with grains of sand and foreign objects; 2, spined acuates more or less bent, of different sizes under 32-6000ths

long, chiefly echinating the fibre *in great abundance*; 3, *angulated* equianchorate, about 3-6000ths long, confined to the sarcode. Structure throughout uniformly compact, tough, and firm, without axial condensation. Size of specimen 11 in. high by $2\frac{1}{2}$ in. in diameter in its widest part.

Depth 6 fath.

Obs. This is evidently a *Plumohalichondria* which, in addition to its self-made or proper spicules, has taken in foreign substances for the axial support of its fibre.

P.S.—The general forms of the specimens respectively above given can only be taken *cæt. paribus* as characteristic of the species, since the growth of sponges is so frequently more or less influenced in their form by the environment, that unless a great number of specimens of the same species have been seen it is impossible to determine this accurately.

[To be continued.]

XXXIII.—*On an Example of Polymorphism in the* Amphipoda. By Charles Chilton, M.A. (New Zealand).

[Plate X.]

Several instances of dimorphism in the Crustacea are already known. Fritz Müller, who seems to have been the first to call attention to examples of it in this group, has given two, one in the Isopoda (*Tanais*)* and one in the Amphipoda (*Orchestia*) †; in each of these cases there are two forms of the male to one of the female. Mr. G. M. Thomson has recorded a similar example from the terrestrial *Orchestia* of New Zealand ‡. From the examination of a large number of specimens of *Orchestia* gathered from several different localities in New Zealand he comes to the conclusion that they all belong to one variable species, *Orchestia sylvicola*, the "males of which have at least two forms of the gnathopoda." Another example is found in *Mœra subcarinata*, Haswell (*M. Petriei*, G. M. Thomson); but here the two forms of the males only differ very slightly from one another. In specimens taken by Mr. Thomson at Stewart Island, New Zealand, the males had "the whole lower surface [of the propodos of the posterior gnathopoda] very densely fringed

* 'Facts for Darwin,' p. 20. † *L. c.* p. 24.

‡ 'Transactions New-Zealand Institute,' vol. xiii. p. 212.

with two rows of long simple hairs," and specimens taken by myself in Sydney agree exactly with this description, while those from Lyttelton Harbour differ in that these long simple hairs are entirely absent, and in having the palm more distinctly defined and more uneven, and the dactylos more rounded at the end *.

As Fritz Müller says, "the occurrence of two kinds of males in the same species may perhaps not be a very rare phenomenon in animals in which the males differ widely from the females in structure. But only in those which can be procured in sufficient abundance will it be possible to arrive at the conviction that we have not before us either two different species or animals of different ages"†. In view of this danger I would like to point out that I have not as yet had a sufficient number of specimens of *Mœra subcarinata* to make me feel quite sure that the two forms are not simply animals of different ages. I am the more doubtful in this case because Mr. Walter Faxon has recently shown that what were considered to be dimorphic forms of the male in certain species of *Cambarus* are really "alternating periods in the life of the individual, the 'first form' being assumed during the pairing-season, the 'second form' during the intervals between the pairing-seasons"‡.

In many genera of the Amphipoda, such as *Mœra*, *Melita*, *Paranœnia*, *Podocerus*, &c., the females of different species are often much more alike than the corresponding males, which usually have some of their limbs abnormally developed; hence if a supposed case of dimorphism or polymorphism occurs in these genera it is more than usually difficult to decide whether we have several species of which the females are alike, or nearly so, or one species with several forms of the male to one of the female. I have, however, an instance to bring forward from the genus *Microdeuteropus*, and, though I have hesitated for a long time, I think I have now sufficient evidence to show that we have here a widely dispersed species which has three forms of the male and only one of the female.

In 1879 Mr. G. M. Thomson described a species of *Microdeuteropus* from Dunedin Harbour, giving it the name of *M. maculatus*; at the same time he recorded the existence of *Aora typica* in New Zealand, the species having been originally obtained at Valparaiso §. In a subsequent paper he

* 'Transactions New-Zealand Institute,' xv. p. 82; 'New-Zealand Journal of Science,' ii. p. 230; and 'Proceedings Linnean Society N. S. W.' vol. ix. part 4, p. 1039.

† 'Facts for Darwin,' p. 24.

‡ 'American Journal of Science,' vol. xxvii. p. 42.

§ Ann. & Mag. Nat. Hist. ser. 5, vol. iv. p. 331.

remarked upon the resemblance of *Microdeuteropus maculatus* to *Aora typica* in the following words:—"Though dissimilar in many respects from *Aora typica*, there is such a strong resemblance in other points that I should not be surprised if they prove to be male and female of the same species, in which case the generic character of *Aora* will require modification. Can it be a case of protective resemblance?" *.

In 1881 I took numerous specimens of *Microdeuteropus maculatus* in Lyttelton Harbour, and with them a form closely resembling them in all respects except in the first gnathopoda, which were "complexly chelate," like those of *Aora typica*, though differing in some minute details; and in a paper published in the 'Transactions of the New-Zealand Institute,' vol. xiv. p. 173, I suggested that most probably this form rather than *Aora typica* was the male of *Microdeuteropus maculatus*. (In referring to this form I shall speak of it as "*Microdeuteropus maculatus* ♂, Chilton.") Afterwards I took *Aora typica* also in Lyttelton Harbour, and was thus able to see that, though it was really somewhat different from *Microdeuteropus maculatus* ♂, Chilton, as I had previously stated, it was, like that form, essentially similar to *Microdeuteropus maculatus* ♀, Thomson, except in the first gnathopoda. About the same time I heard by letter from Mr. Thomson that he had taken a large number of specimens of *Aora typica* and *Microdeuteropus maculatus* ♀, both at the same locality, and felt convinced that they both belonged to one species. While in Sydney, in January 1884, I obtained specimens of *Microdeuteropus Mortoni*, Haswell, and also of *M. tenuipes*, Haswell. One of my specimens of the latter species was a female bearing eggs, and from the close resemblance of the two I suggested † that *M. Mortoni* was probably the male of *M. tenuipes*. I also remarked upon the very close resemblance between *M. tenuipes* and *M. maculatus* ♀, and between *M. Mortoni*, *M. maculatus* ♂, Chilton, and *Aora typica*, in all points except in the first gnathopoda; but at the time I left the species as distinct, until further evidence should be forthcoming. Since then I have examined the various forms more minutely, and have compared them with Dunedin and Stewart-Island specimens of *M. maculatus* ♀ and *Aora typica*, which were very kindly placed at my disposal by Mr. Thomson, and I now feel convinced that they all belong to one species, of which we therefore now know three forms of the male and one of the female.

The different forms vary somewhat in several small points;

* 'Transactions New-Zealand Institute,' xiii. p. 218.

† 'Proceedings Linnean Society N. S. W.' vol. ix. part 4, p. 1040.

thus the relative lengths of the various joints of the antennæ are subject to slight variations; in large specimens the lower antennæ increase in length as compared with the upper, and the flagellum of the upper antenna decreases in length as compared with the peduncle.

The stout curved setæ on the end of the flagellum of the lower antenna in *Microdeuteropus tenuipes*, mentioned by Mr. Haswell, are present in the other forms; but in many of the specimens they are not very prominent, and they have consequently not been mentioned by other observers.

Mr. Thomson described the appendage to the mandible of *Microdeuteropus maculatus* as *two*-jointed. In *M. Mortoni*, *M. tenuipes*, in the Lyttelton specimens of *M. maculatus*, both male and female, and of *Aora typica*, it is *three*-jointed, as is almost universally the case with the Amphipoda, and in the Dunedin specimens of *M. maculatus* and *Aora typica* which I dissected I found it also three-jointed; the first and second joints lie nearly in the same straight line, and though the division between them is distinct enough, they do not appear to be very movable one upon the other; and I fancy this has given rise to the error in Mr. Thomson's description, which is in all other respects exceedingly accurate. In this species, as in many others of the Amphipoda, the cutting-edge of the mandible is not quite the same on the right side as on the left, but the differences in this case are small. On the distal portion of the third joint of the appendage are two rows of long serrated hairs, of which those at the end are the longest and are most closely approximated to one another, and between these are two rows of short straight setæ. It is not very easy to get a good view of these rows in the proper position; when seen in side view they present the appearance of a dense fringe on one side of the joint, as shown in Mr. Thomson's figure*. In his description of *Aora typica* Mr. Thomson says, "telson quite smooth." In all the specimens that I have examined the telson is essentially the same as in *Microdeuteropus maculatus*, viz. the projecting portion on each side is slightly notched at the end and bears one or two slender spinules.

It is curious to note the variations in the parts in which the males and females of different species of the Amphipoda resemble and differ from one another. Thus in some species of *Mæra*, such as *M. subcarinata*, *M. festiva*, and in *Melita tenuicornis*, *Podocerus frequens*, *Podocerus longimanus*, *Paranœnia typica*, *Nicea egregia*, &c., the male differs from the female in the structure of the *second* pair of gnathopoda, while

* Ann. & Mag. Nat. Hist. ser. 5, vol. iv. pl. xvi. fig. 7.

in all these species the *first* pair are the same in the male as in the female. In the forms under consideration exactly the reverse is the case: the male forms differ from the female in the structure of the *first* pair of gnathopoda, while in *Aora typica*, *Microdeuteropus Mortoni*, *M. tenuipes*, *M. maculatus* ♂, and *M. maculatus* ♀, the *second* pair of gnathopoda is essentially the same throughout; and the following description drawn up from Lyttelton specimens of *M. maculatus* ♀ will apply, with the slight variations afterwards mentioned, to the second gnathopoda of all the other forms.

The meros (see Pl. X. fig. 5) is rather pointed distally and has the distal margin supplied with a row of long setæ; the carpus is triangular, the inferior or posterior edge rounded and abundantly supplied with setæ arranged in short transverse rows, the setæ being longest towards the distal end; there is also on the side of the carpus, near its distal end, an oblique row of about six long setæ, and more proximally a much shorter row of from two to three setæ; on the upper or anterior margin are two or three small tufts, the last being situated at the antero-distal angle; the propodos is of the same width as the carpus and has the palm slightly convex, transverse, or but slightly oblique, very minutely serrated, and with a somewhat irregular fringe of rather short setæ, and defined by a stout seta; the posterior edge of the propodos is thickly supplied with setæ arranged in about six short transverse rows or tufts; on the anterior edge are five similar rows, each containing about five setæ, the last one being at the base of the dactylos, and on the side of the dactylos are four or five similar short transverse rows of setæ, arranged in one longitudinal line; the dactylos is fairly stout, inner edge finely serrated, the serrations increasing in size until near the extremity, which is, however, smooth. All the setæ on the posterior margin of the meros, carpus, and propodos appear to be serrated throughout the distal half of their length, and many are slightly bent in the centre, while those on the palm and on the anterior margin of the various joints are simple.

In the specimens of *Microdeuteropus maculatus* ♀ which Mr. Thomson sent me the second gnathopoda agreed very closely with the description given above, but had the palm rather more transverse than in my Lyttelton specimens. *Aora typica*, both Lyttelton and Dunedin specimens of which were examined, also agrees with this description, but has the palm more oblique, and generally has a greater number of setæ than in *Microdeuteropus maculatus* ♀, though they are arranged in precisely the same manner.

The first gnathopod (see Pl. X. fig. 6) of *Microdeuteropus*

maculatus ♀ is somewhat larger than the second, but is of the same general shape; the carpus bears numerous setæ irregularly arranged on the posterior margin; on the anterior margin there is only one tuft at the antero-distal angle; the propodos is supplied with many setæ arranged as in the second gnathopod; the palm is very oblique, slightly curved, and is defined by a stout spine or seta, which is much more prominent than the corresponding one in the second gnathopod. The length of the palm varies considerably; in a tracing of a drawing made by Mr. Thomson, which he has sent me, the palm is represented as occupying almost the whole of the posterior margin of the propodos; in the figure which I give (Pl. X. fig. 6), taken from a female bearing eggs, it is scarcely more than half as long as the propodos; it most probably increases in length with the age of the animal. The dactylos is stout and strongly curved, and is similar to that of the second gnathopod.

In *Aora typica* (see Pl. X. fig. 2) the coxa of the first gnathopod is produced anteriorly into a sharp point, as in *Aora gracilis* *; the basos is long and is produced into a tooth on the anterior margin at a point not far from the base of the joint; there are a few very small setæ at intervals along the anterior margin; at the distal end the integument is produced anteriorly and distally, so as to form a thin plate, which interlaps with a similar but larger plate arising from the ischios. The meros is produced inferiorly into a long acute spine, which is as long or very nearly as long as the carpus; the carpus is longer than the propodos, sides parallel, posterior with a few small tufts of setæ near the distal end; propodos slightly arcuate, with no distinguishable palm in *full-grown specimens*; the distal portion thickly covered with long hairs, arranged in short transverse rows and most numerous at the base of the dactylos. Dactylos slightly curved, of nearly the same width throughout until it narrows suddenly near the end.

In smaller and presumably younger specimens there is a stout seta about the centre of the inferior margin of the propodos, marking off what may be considered a "palm;" this is entirely absent in large specimens (see Pl. X. fig. 3). In these young males the first gnathopod is much more like the first gnathopod of the female than in the full-grown males. I have already described a case similar to this in *Podocerus longimanus* †.

* See Bate and Westwood, 'British Sessile-eyed Crustacea,' figure on p. 281, vol. i.

† 'Transactions New-Zealand Institute,' xvi. p. 256.

The plates into which the integument is produced on the outer sides of the basos and ischios interlap, and appear thus to strengthen the joints, which would otherwise be weak for so long a limb, and they also serve to keep the carpus firmly in its place when that joint is laid back upon the basos, as it usually is when the limb is not being used. The tooth on the anterior margin of the basos seems to be of use for the same purpose. Spence Bate speaks of it as "an apparently useless tooth" *.

In *Microdeuteropus maculatus* ♂, Chilton (see Pl. X. fig. 1), the first gnathopod has the basos long, expanding slightly distally; ischios nearly twice as long as broad, both joints being almost free from setæ; the meros is narrow and is produced inferiorly into a long acute spine reaching beyond the end of the carpus; it is slightly curved towards the extremity and bears on its inferior or posterior margin a small tuft of setæ at about one third of the length of the joint from its extremity; the carpus is very large, more than twice as long as broad, and bears a very few short setæ at the distal end; the propodos is rather more than half the length of the carpus, and is much narrower, and becomes narrower towards the distal end; inferior margin very slightly concave and thickly fringed with setæ more or less regularly arranged in tufts; there is also a tuft on the anterior margin at the base of the dactylos; dactylos more than half as long as the propodos, narrowing regularly towards the extremity, where there are a few short setæ on the inner margin.

In general shape the first gnathopod of *Microdeuteropus Mortoni*, Haswell (see Pl. X. fig. 4), closely resembles that of *M. maculatus* ♂, Chilton, but the setæ are very different, and there are also a few other small differences: the anterior edge of the basos bears a thick fringe of rather long setæ; these setæ are sparsely plumose towards the distal ends; similar setæ are found on the anterior edge of the ischios and on both lateral borders of the meros, which is hollowed out anteriorly to receive the carpus; the setæ on the meros are more or less regularly arranged in tufts, but the acute-pointed end of the joint is naked; ordinary simple setæ are found on the anterior margin of the carpus and on both margins of the propodos; the dactylos is very long, fully as long as the propodos, and bears three or four tufts of setæ on its concave margin.

It is evident from what I have already said that the genera

* 'British Sessile-eyed Crustacea,' i., Introduction, p. li.

Aora and *Microdeuteropus* will have to be combined *; and as *Aora* is the older genus, that name will have to be retained. The specific name *typica* has priority over all the others, so that the name of our species will be *Aora typica.*

I give the synonymy so far as known to me and brief diagnoses of the various forms.

Aora typica.

Aora typica, Kröyer, Tidsskr. ser. 2, p. 328, pl. iii. fig. 3; Spence Bate, Cat. Brit. Mus. Amphip. p. 161, pl. xxix. fig. 3; G. M. Thomson, Ann. & Mag. Nat. Hist. ser. 5, vol. iv. p. 331; Trans. New-Zealand Inst. vol. xiii. p. 216.

Lalaria longitarsis, Nicolet, Gay's Hist. de Chile, iii. pl. ii. fig. 8.

Microdeuteropus Mortoni, Haswell, Proc. Linn. Soc. N. S. W. vol. v. p. 339, pl. xxii. fig. 2; Cat. Australian Crust. p. 264; Chilton, Proc. Linn. Soc. N. S. W. vol. ix. p. 1040.

Microdeuteropus tenuipes, Haswell, *l. c.* vol. v. p. 339, pl. xxii. fig. 1; Chilton, *l. c.* vol. ix. p. 1040.

Microdeuteropus maculatus, G. M. Thomson, Ann. & Mag. Nat. Hist. ser. 5, vol. iv. p. 331, figs. 5-8; Trans. N.-Z. Inst. vol. xiii. p. 217, figs. 7 A, B, and C; Chilton, Trans. N.-Z. Inst. vol. xiv. p. 173, fig. 3, *a–b*.

Female. Animal smooth, slender. Superior antennæ considerably longer than inferior; second joint of peduncle long and slender; third short, and furnished with a 5–6-jointed secondary appendage; flagellum very slender, many-jointed, sparingly ciliated. Inferior antennæ strong, subpediform; third joint of peduncle short, fourth and fifth very long; flagellum shorter than last joint of peduncle, with stout curved setæ in addition to the ordinary slender hairs. Gnathopoda of moderate size, both strongly ciliated; first pair the largest; propodos about as large as the carpus; palm very oblique, almost longitudinal, slightly curved, and defined by a strong spine; dactylos serrated on inner margin; second pair similar, but with palm transverse or but slightly oblique. Fourth and fifth pairs of pleopoda with stout straight spines; sixth pair with two or three spines like those of the preceding pairs, and with a few longer and more slender spines or hairs. Telson raised on each side into an upward projection, each having the apex notched and bearing two or three slender spinules.

Male. Three forms, all differing from the female in the character of the first gnathopod, which in each has the meros produced into a long spine reaching about to the end of the carpus.

* The necessity for this was indeed recognized by the Rev. T. R. R. Stebbing as far back as 1878. See Ann. & Mag. Nat. Hist. ser. 5, vol. ii. p. 369.

The forms may be distinguished as follows:—

1. (*Aora typica*, Kröyer.)—Basos with a tooth projecting forwards on the anterior margin; carpus longer than the propodos, but of about the same breadth.

2. (*Microdeuteropus maculatus* ♂, Chilton.)—Carpus longer and broader than propodos; meros with small tuft of setæ on posterior margin.

3. (*Microdeuteropus Mortoni*, Haswell.)—Carpus longer and broader than the propodos; meros hollowed anteriorly and with each lateral margin densely fringed with setæ; dactylos as long as propodos and with two or three tufts of setæ on concave border.

EXPLANATION OF PLATE X.

Aora typica.

[All the figures much enlarged.]

Fig. 1. First gnathopod of male, *second* form (*Microdeuteropus maculatus* ♂, Chilton).
Fig. 2. First gnathopod of male, *first* form (*Aora typica*), seen from outer side.
Fig. 3. First gnathopod of an immature specimen of the same form, seen from the inner side.
Fig. 4. First gnathopod of male, *third* form (*Microdeuteropus Mortoni*).
Fig. 5. Second gnathopod of female (*M. maculatus*).
Fig. 6. First gnathopod of female (*M. maculatus*).

XXXIV.—*Notes on Australian Lepidoptera, with Descriptions of new Species.* By Rudolph Rosenstock, B.A.

[Plate XI.]

The following is an account of a small collection of Lepidoptera from South Australia forwarded to the British Museum by Dr. Lucas, of Melbourne.

A number of the specimens were unfortunately in poor condition, being either broken or so much worn as to render identification difficult; and description, in the case of some possibly new species, undesirable. I am nevertheless enabled to describe twenty-eight species, in better condition than those just mentioned, as new to science.

The Microlepidoptera were well represented, as one might expect in collections from this region.

Mr. Meyrick's labours in this division of Lepidoptera afforded me much aid, though I discovered one or two

omissions of described species, as well as occasional inaccuracies in the description of the venation, hardly to be expected from so careful a worker.

Unfortunately the concluding portion of the paper on the Acophoridæ has not yet reached me, and I am in consequence obliged to omit one or two species, the genera of which I believe I succeeded in identifying by the introductory tables.

In conclusion, I must express my thanks to Lord Walsingham for kindly allowing me to examine the Australian Microlepidoptera in the Zeller collection, as well as a small number of specimens received from Mr. Meyrick.

Unless where otherwise stated, single specimens only of each species were received.

RHOPALOCERA.

Lycænidæ.

IALMENUS, Hübn.

(918.) *Ialmenus evagoras*, Donov.

Ialmenus evagoras, Donov. Ins. New Holl. t. xxx. fig. 1 (1805).

(919.) *Ialmenus ictinus*, Hew.

Ialmenus ictinus, Hew. Ill. D. L. p. 54. n. 2, t. xxiv. figs. 6–8.

LYCÆNA, Fabr.

(707.) *Lycæna mœrens.*

Closely allied to *L. erinus*, Fabr. (Don. Ins. N. Holl. pl. xxxi. fig. 3), but smaller and much darker. The wings of a dull greyish black, the blue being pronounced only on extreme base of fore wings and upon abdominal area of hind wings. Underside cinereous, differing from *erinus* (1) in the enlargement of the lower three instead of two of the submarginal row of spots; (2) in the presence on the apical region of the hind wing of a large irregular blackish-grey subapical blotch; (3) instead of the series of sagittate markings of *erinus*, the wings are traversed by three distinct parallel rows of blackish dots; (4) fringes white-spotted, resembling *Holochila anita*, Semper (Journ. d. Mus. Godeffroy, xiv. p. 163).

LUCIA, Swains.

(831.) *Lucia ? pyrodiscus.*

Lucia ? pyrodiscus ♂, Newm. MS. in B. M.

Brownish black, with a reddish-purple tinge.

Fore wings with the disk deep fiery golden metallic: hind wings duller brownish golden-yellow, without metallic sheen on the submedian area; fringes whitish grey, with a blackish basal line, in the hind wings irrorated with brownish yellow.

Underside.—Pale whity brownish café-au-lait colour, with a series of dark fuscous paler whitish-margined markings, cordiform (in outline), and disposed in transverse rows across the wings; two deep chocolate-brown semilunar spots on anal angle of hind wings, continued anteriorly by a row of similar but very much fainter submarginal spots, hardly distinguishable on the fore wings; head, palpi, thorax, and abdomen blackish brown above, whitish beneath; antennæ alternately black- and white-ringed, the clubs black, brownish red at tips and underneath.

I have referred this species to the genus *Lucia*. Butler, followed by Semper, places it and the allied species *limbaria*, Swains., = *aurifer*, Blanch., under *Zeritis*; but I fail to see any resemblance to Boisduval's type of that genus (*Z. neriene* (Guinea), Boisd. Sp. Gen. pl. xxii. fig. 6). The venation, too, of *Zeritis*, as represented in Boisduval's figure, is entirely different from what I observe in my species, which, on the other hand, in this respect perfectly agrees with *Lucia limbaria*. In *Zeritis* three subcostal branches are emitted from beyond the angle of the cell, while only one radial vein, presumably the lower, is figured. In *limbaria* and *aurifer* two subcostal branches only rise from a common stalk, emitted from the angle of the cell, while an upper radial vein issues from the same point, and the lower radial is emitted at the middle of the discocellular veins.

Hesperidæ.

Pamphila, Fabr.

(384.) *Pamphila lascivia*, n. sp. (Pl. XI. fig. 1.)

Golden brownish black; palpi with basal and second joints covered with whitish-yellow hairs; terminal joints black, naked; thorax and abdomen black, with deep olivaceous yellow hairs above, pale olivaceous whitish beneath; anal tuft deep yellow-ochreous.

Upperside.—Fore wings: inner two fifths of costal margin, interior of cell, first, second, and third subcostal branches bordered with deep golden yellow, and a submarginal band of six orange-yellow spots. Hind wings with a transverse band of oblong deep golden-yellow spots, starting from below costa near apex, and directed towards middle of abdominal margin, which, however, it does not reach.

Under surface.—Fore wings: costal border, apical region deep yellow; rest of wing brownish black; submarginal spots as above. Hind wings yellow ochreous, with a faint longitudinal brownish-black stripe, attenuated above, parallel to abdominal margin.

Expanse of wings 25 millim.; length of body 13 millim.

Trapezites, Hübn.

(412.) *Trapezites symmomus*, Hübn.

Trapezites symmomus, Hübn. Zutr. ex. Schmett. figs. 225, 226.

(828.) *Trapezites iacchus*, Fabr.

Pap. iacchus, Fabr. Syst. Ent. p. 533. n. 389; Donov. Ins. New Holl. t. xxxi. fig. 1.

Telesto, Boisd.

(829.) *Telesto ornata*, Leach.

Hesp. ornata, Leach, Zool. Misc. i. p. 126, t. lv. figs. 4, 5.

(830.) *Telesto donnysa*, Hew.

Telesto donnysa, Hew. Descr. Hesp. p. 39. n. 3 (1868).

(726.) *Telesto Doubledayi*, Feld.

Telesto Doubledayi, Feld. Verh. zool.-bot. Ges. xii. p. 491. n. 180 (1862); Herr.-Schäff. Ex. Schmett. fig. 112.

(393.) *Telesto scepticalis*, n. sp. (Pl. XI. fig. 2.)

Golden brownish black; head, thorax, and abdomen deep black above, covered with greenish yellowish white hairs below; antennal joints black, ringed with yellow above, below yellow, club black, below reddish brown; palpi, front of thorax, and anterior part of upperside of abdomen covered with intermingled blackish and olivaceous hairs; anal tuft brownish ochreous.

Upper surface.—Basal region of both wings covered with deep yellow hairs; fore wings with an irregularly oblong yellow discocellular mark; three connected small pale yellow subcostal spots at about three fourths length of wings, two larger well-defined yellow spots obliquely in front of and below discocellular spot, and a small sagittate spot below these a little above and beyond middle of hind margin. Hind wings with a single large yellow oblong discocellular spot. Fringes all deep yellow, alternately mixed with black.

Underside.—Fore wings: costal region and upper portion of wing brownish ochreous; rest of wing blackish, except at inner

margin, which is olivaceous yellow; upper two thirds of outer margin bordered by a greyish-blue (glaucous) elliptical patch.

Hind wings reddish brown, clouded with greyish blue, with a paler, whity-brown, broad, angulated median band, not reaching costa or hind margin, and bordered anteriorly and posteriorly by a row of grey-blue deeply brown-ringed interneural spots, those of the inner row fainter and less distinct.

Expanse of wings 26½ millim.; length of body 14 millim.

Heterocera.

Hepialidæ.

Three much worn specimens only have come to hand, the species being quite undeterminable.

Two specimens (635) are apparently male and female, perhaps of *Fraüs simulans* (Stephens, MSS., Walk. Cat. vii. p. 1564).

The other specimen (365) is much larger and also a *Fraüs*.

Cossidæ.

Cossus, Fabr.

Cossus ligatus, Walk.

Cossus ligatus, Walk. B. M. Cat. L. H. Suppl. ii. p. 585.

Also a much worn specimen.

Castniidæ.

Synemon, Doubl.

(724.) *Synemon hesperioides*, Feld.

Synemon hesperioides, Feld. Novara Heterocera, pl. lxxxii. fig. 12.

Agaristidæ.

Agarista, Leach.

(206.) *Agarista affinis*, Boisd.

Agarista affinis, Boisd. Voy. de l'Astrolabe, pt. i., Lep. p. 177.

Zygænidæ.

Syntomis, Ochs.

(424.) *Syntomis aperta* ♀, Walk.

Syntomis aperta ♀, Walk. *l. c.* Suppl. i. p. 72.

Lithosiidæ.

ASURA, Walk.

(220.) *Asura cervicalis*, Walk.

Asura cervicalis, Walk. *l. c.* ii. p. 484.

EUTANE, Walk.

(290.) *Eutane lydia*, Donov.

Lithosia lydia, Donov. Ins. New Holl. pl. xl. fig. 1.

TIGRIOIDES, Butl.

Tigrioides, Butl. Trans. Ent. Soc. 1877, p. 359.

(763.) *Tigrioides transversa* ♂, Walk.

Lithosia transversa, Walk. *l. c.*

Walker describes a single female. I have little doubt that no. 763, which is rather rubbed, is the male of this species; the markings agree perfectly. Herrich-Schäffer's *Lithosia histrionica* (Exot. Schmett. fig. 440) is a synonym of Butler's type of the genus (*Setina alterna*, Walk.).

TERMESSA, Walk.

(274.) *Termessa læta*, Walk.

Termessa læta, Walk. *l. c.* vii. p. 1689.

MOSODA, Walk.

(618.) *Mosoda anartoides*, Walk.

Mosoda anartoides, Walk. *l. c.* Suppl. v. p. 1899.

(445.) *Mosoda consolatrix*, n. sp.

This species closely resembles *Halone sobria*, Walk., Natal. I failed to detect any essential generic differences between the latter genus and *Mosoda*.

Head, antennæ, thorax, and abdomen greyish fuscous; hind tibiæ pale whitish ochreous, naked, with four spines.

Fore wings greyish brown, irrorated with whitish grey, and with some obscure indefinite dark brownish maculate bands.

Hind wings stramineous yellow; apex suffused with greyish fuscous.

A worn specimen. Expanse 22 millim.

(224.) *Mosoda jocularis* ♂, n. sp. (Pl. XI. fig. 6.)

Head black, with lateral white spots; antennæ strongly

pubescent, dark fuscous; palpi obliquely ascendant, black; proboscis strong, reddish amber-coloured; thorax greyish black, with lateral patches of white scales; collar white; tegulæ blackish, edged with long whitish hairs; legs dark greyish, hind tibiæ and tarsi yellow; abdomen deep yellow, smoky black near base.

Fore wings white, yellow-tinged along hind margin, with a falciform blackish basal mark commencing upon costa, but not reaching hind margin; a black transverse line from costa at two fifths of its length, attenuated posteriorly; a well-defined black circular discocellular dot, with a small blackish costal spot above and an indistinct sagittate mark below; an irregular submarginal band with outward angular projections abutting upon the narrow, blackish, hind marginal border.

Hind wings pale stramineous yellow; apex suffused with black, and a small blackish discocellular spot.

Expanse of wings 20 millim.; length of body 7 millim.

PHILENORA, n. g.

Antennæ of male strongly pectinated; palpi short, clothed with appressed hairs, porrected, hardly projecting beyond head; face obtusely conical; proboscis strong; thorax subovate, moderately convex, with prominent collar and short side tegulæ; abdomen slender, not extending beyond hind wings in male, with strong anal tuft. Fore wings subtriangular, with rounded apex, oblique outer and slightly sinuate inner margins.

Allied to *Mosoda*, Walk., but differing in the strongly pectinated antennæ, which are merely pubescent in the latter genus, and in the neuration of the fore wings, vein 10 (second subcostal branch) being emitted at upper angle of cell from same point as 9 and the common stalk of 7 and 8, and 11 from the anterior fourth of the cell; whereas in *Mosoda* 10 rises from the subcostal from before the angle of the cell, and 11 behind it from posterior third to half of cell.

(18.) *Philenora undulosa* ♂, Walk.

Acontia undulosa, Walk. *l. c.* xii. p. 797.

Walker wrongly described the female of this species as an *Acontia*. I was therefore obliged, in the absence of any other corresponding Lithosiid genus, to create a new one for its reception.

The male of this species, besides difference of antennal characters and smaller size, has the white ground-colour of the fore wings somewhat obscured by grey, rendering the transverse markings fainter. Expanse 22 millim.

Liparidæ.

EUPROCTIS, Hübn.

(228.) *Euproctis obsoleta* ♂, Fabr.

(354.) *Euproctis obsoleta* ♀, Fabr.

Bombyx obsoleta, Fabr. Syst. Ent. p. 579. n. 77; Donov. Ins. New Holl. pl. xxxv. fig. 1.
Liparis obsoleta, Boisd. Voy. de l'Astrolabe, pt. 1, Lep. p. 218.

THALAINA, Walk.

(650.) *Thalaina inscripta*, Walk.

Thalaina inscripta, Walk. *l. c.* iii. p. 661.
Plusargyria principiaria, Herr.-Schäff. Exot. Schmett. fig. 440.

Walker's description was published in 1855; Herrich-Schäffer's figure appeared in 1856, and his name is therefore a synonym.

LERNA, Walk.

Lerna nivosa, Walk.

Lerna nivosa, Walk. *l. c.* Suppl. iii. p. 805.

Placed by Walker among the Anthophilidæ, but undoubtedly a Liparid.

EPICOMA, Hübn.

Marane, Walk. *l. c.* Suppl. ii. p. 397.

Epicoma pontificalis ♀, n. sp.

Closely resembles *Epicoma contristis*, Hübn. Zutr. ex. Schmett. iii. figs. 217 and 218, but differs (1) in the outer border of the yellow discal suffusion on the under surface of the fore wings being quite straight instead of notched in the middle; (2) in the absence on the under surface of the hind wing of a yellow submarginal band inside of the yellow border (in this character it agrees with *Bombyx tristis* ♀, Lewin, Lepid. Ins. N. S. Wales, pl. viii. fig. 4, in which, however, this band is absent on the front wing also); (3) in the abdomen having only a single yellow spot placed on the middle of the dorsal surface.

SITINA, Walk.

(420.) *Sitina*, sp.

A much worn and quite undeterminable specimen.

SEZERIS (*Cebysa*), Walk.

(281.) *Sezeris conflectella*, Walk.

Sezeris conflectella, Walk. *l. c.* xxviii. p. 509.

Described as a Tineid.

Lasiocampidæ.

OPSIRRHINA, Walk.

(325.) *Opsirrhina obscura*, Walk.

Lebeda obscura, Walk. *l. c.* vi. p. 1464.

Two specimens, a male and a female.

PTEROLOCERA, Walk.

(86.) *Pterolocera amplicornis*, Walk.

Pterolocera amplicornis, Walk. *l. c.* iv. p. 885.

COLUSSA, Walk.

(269.) *Colussa simplex*, Walk.

Darala simplex, Walk. *l. c.* iv. p. 891.

(217.) *Colussa basigera*, Walk.

Darala basigera, Walk. *l. c.* Suppl. ii. p. 372.
Darala undulata, Feld. Novara Het. pl. xcviii. fig. 11.

(56.) *Colussa vinosa*, n. sp.

Purplish vinous red, irrorated with black and ochreous yellow. Head, palpi, and thorax dark sienna-red; antennæ pale-grey whitish; legs pale yellowish grey, speckled with greyish black.

Upperside.—Fore wings with the submarginal area densely irrorated with ochreous yellow, and with two faint, parallel, punctiform, submarginal, zigzag lines. Two black punctiform discal spots, an inner one within the cell, and an outer one upon the middle of the discocellular vein. Hind wings somewhat paler than fore wings, with markings similar; abdominal margin with pale reddish-brown hairs; fringes pale vinous reddish.

Underside.—Paler, with markings on both wings similar, but more distinct. Expanse 45 millim.

The specimen had no body and was much worn.

NATAXA, Walk.

(420.) *Nataxa flavifascia*, Walk.

Nataxa flavifascia, Walk. *l. c.* v. p. 1179.

Described among Drepanulidæ, but undoubtedly a Lasiocampid of the *Limacodes* group.

[To be continued.]

XXXV.—*Note on* Laceripora cribrosa, *Eichwald.* By ROBERT ETHERIDGE, Jun., and ARTHUR H. FOORD, F.G.S.

WE desire to make a correction in the name of the genus to which we assigned *Laceripora cribrosa*, Eichw.* It was described in our paper as a *Chætetes*; but Prof. H. A. Nicholson, who has recently returned from Esthonia, Russia, has brought a number of specimens of it, sections of which show incontestably that it is not a *Chætetes*, but a highly perforated Favositoid Coral. We are of opinion, moreover, that Eichwald's generic name should be retained. The sections which were prepared to illustrate our paper showed no trace of mural perforations, owing, in a great measure, to the unsatisfactory state of preservation of the only examples available at the time. The accompanying woodcut shows the true characters of this interesting form, as seen in a vertical section.

In this the unusually large size of the mural pores is apparent, and they impart that peculiar appearance to the cells which

* This Journal, Nov. 1884.

was shown in the transverse section (1 *a*) given in our plate, and which led Eichwald to adopt the term *Laceripora* for his genus. The structures described by us as "incipient divisions of the cells" are thus accounted for.

Dr. Lindström's later views, as quoted in our paper, are therefore quite acceptable, viz. that *Laceripora* should be retained as a distinct genus of the Favositidæ; and in this opinion Dr. H. A. Nicholson also concurs.

XXXVI.—*Remarks on Mr. C. W. De Vis's recent Contributions to the Herpetology of Australia**. By G. A. Boulenger.

It is painful to have to record such contributions as Mr. De Vis's herpetological papers, but it is a duty for the working zoologist, who constantly complains of the plague of synonymy, not to allow them to pass without protest. Their author is no doubt stimulated by the desire of promoting herpetological knowledge in his country, but, through his incompetence and want of care, he will do much harm. As regards certain groups of Reptiles he may, in defence, point to the great difficulties attending these studies owing to the absence of general treatises; but when he has in his hands the recent 'Catalogue of Batrachians in the British Museum,' and is not even able to distinguish a *Rana* from a *Hyla*, or to recognize so striking a form as *Mixophyes*, he has no excuse, and one can only wonder at his daring to write on subjects of which he is so manifestly ignorant.

The papers in question contain descriptions of no less than thirty new species, several of which are made the types of new genera. I have no time at present to go through the whole of them, and must restrict my remarks to the groups which I have fully worked out, viz. the Batrachians and the Lizard-families Geckonidæ and Agamidæ. Mr. De Vis's additions to those groups amount to fifteen new species, which are enumerated below. Of these, three appear to deserve recognition, one is doubtful, the rest are synonyms of species previously named.

1. *Limnodynastes lineatus* (Proc. Linn. Soc. N. S. W. ix. 1884, p. 65) = *L. Peronii* (D. & B.).

* Proc. Linn. Soc. N. S. Wales, ix. 1884, and Proc. Roy. Soc. Queensl. i. 1884–85.

2. *Limnodynastes olivaceus* (*l. c.* p. 66). A good species.

3. *Hyla Rothii* (*l. c.* p. 66) = *H. Peronii*, Bibr.
   Of these three species, type specimens are now in the Natural-History Museum, through the kindness of H. Ling Roth, Esq.

4. *Œdura Tryoni* (Proc. R. Soc Queensl. i. p. 54, 1884) = *Œ. ocellata*, Bouleng. Cat. Liz. i. p. 105, pl. ix. (1885).
   Although very imperfect the description is recognizable, and as the name *Tryoni* has priority that of *ocellata* must be cancelled.

5. *Amphibolurus branchialis* (*l. c.* p. 55) = *Physignathus Lesueurii*, Gray (figured in Dum. & Bibr. Erp. Gén. pl. xl. and in McCoy's Prodr. Zool. Vict. dec. ix. pl. lxxxi.).

6. *Macrops* (g. n., a name already applied to three different genera in zoology) *nuchalis* (*l. c.* p. 97) = *Amphibolurus reticulatus* (Gray).

7. *Diporophora nuchalis* (*l. c.* p. 98) = *D. australis* (Steind.).

8. *Diporophora ornata* (*l. c.* p. 99) = *D. australis.*

9. *Diporophora brevicauda* (*l. c.* p. 99) = *D. bilineata*, Gray.

10. *Diporophora pentalineata* [!] (*l. c.* p. 99) = *D. bilineata.*

11. *Hyla fenestrata* (*l. c.* p. 128) = *Mixophyes fasciolatus*, Gthr. (figured in P. Z. S. 1864, pl. vii.).

12. *Hyla irrorata* (*l. c.* p. 128). Should be compared with *H. infratæniata*, Gthr.

13. *Hyla nobilis* (*l. c.* p. 129) = *Rana papua*, Lesson.

14. *Hyla peninsulæ* (*l. c.* p. 129) = *H. nasuta* (Gray).

15. *Œdura fracticolor* (*l. c.* p. 160). Apparently a distinct species, if referred to the correct genus.

I take this opportunity of changing the name *Ælurosaurus*, which I employed for a genus of Geckos (Cat. Liz. i. 1885), but which is preoccupied by a Theriodont (*Ælurosaurus*, Owen, 1881), to that of *Æluroscalabotes.* I am obliged to my colleague Mr. Smith Woodward for calling my attention to this matter.

XXXVII.—*A List of Reptiles and Batrachians from the Island of Nias.* By G. A. Boulenger.

The following list is based on several collections recently transmitted to the Natural-History Museum by Dr. M. Schreiber. The collector is Hr. Sandemann. The herpetological fauna of Nias has already formed the subject of a paper by Dr. J. G. Fischer †, who enumerates twenty-two Reptiles and three Batrachians. Twenty-seven Reptiles and six Batrachians are recorded below, of which eleven of the former and four of the latter (preceded by an asterisk) are not mentioned in Fischer's list. On the other hand, the following species recorded in the latter have apparently not reached us :—*Gehyra mutilata*, Wiegm.; *Tiliqua sulcata*, Ptrs.; *Tiliqua percarinata*, Ptrs.; *Ablabes ornatus*, Schleg.; *Ablabes baliodirus*, Schleg.; *Callophis flaviceps*, Cant.; and *Rana chalconota*, Schleg. The snake described by Fischer as *Simotes affinis*, sp. n., I identify as *S. labuanensis*, Gthr.; and his *Trimeresurus erythrurus*, Cant., var., I suspect to be *T. formosus*, Schleg.

REPTILIA.

*1. *Hemidactylus frenatus*, D. & B.

2. *Gecko stentor* (Cant.).

3. *Gecko monarchus* (D. & B.).

*4. *Ptychozoon homalocephalum* (Crev.).

5. *Draco volans*, L.

*6. *Aphaniotis fusca*, Ptrs.

7. *Gonyocephalus grandis* (Gray).

8. *Calotes cristatellus* (Kuhl).

*9. *Tiliqua rufescens* (Shaw).

10. *Xenopeltis unicolor*, Reinw.

*11. *Calamaria Stahlknechti*, Stol.

Three specimens of a *Calamaria* agree so well in most respects with Stoliczka's description of *C. Stahlknechti* (Journ. As. Soc. Beng. xlii. 1873, p. 119, pl. xi. fig. 2), from Sumatra, that I can separate them only as a colour-variety. The lower surface of the body is either uniform yellowish or

† Abhandl. naturw. Ver. Hamburg, ix. (1885).

with distant, ill-defined, black cross bars. Ventrals 147, 148, 150; caudals 23, 22, 22.

*12. *Pseudorhabdion longiceps* (Cant.).

13. *Simotes labuanensis*, Gthr.

*14. *Simotes octolineatus* (Schn.).

15. *Oligodon trilineatus* (D. & B.).

16. *Tropidonotus trianguligerus*, Boié.

17. *Tropidonotus chrysargos*, Boié.

*18. *Hypsirhina albomaculata*, D. & B.

*19. *Zapyrus fuscus*, Gthr.

20. *Chrysopelea ornata* (Shaw).

21. *Dendrophis picta* (Gm.).

22. *Dendrophis caudolineata* (Gray).

23. *Dryophis prasina*, Reinw.

*24. *Ophites subcinctus* (Boié).

*25. *Ophites albofuscus* (D. & B.).

An adult specimen measures 177 centim. Uniform blackish brown above, white inferiorly. Ventrals 238; caudals 155.

26. *Callophis intestinalis* (Laur.).

27. *Bothrops formosus* (Schleg.).

BATRACHIA.

1. *Rana macrodon*, Kuhl.

*2. *Rana nicobariensis* (Stol.).

Hylorana nicobariensis, Stoliczka, Journ. As. Soc. Beng. 1870, xxxix. p. 150, pl. ix. fig. 2.

Very closely allied to *R. alticola*, Blgr., from which it is distinguished by the rather longer toes, the length of the foot nearly equalling that of the tibia. In *R. alticola* the foot measures about three fourths the length of the tibia. A single specimen, obtained from the stomach of a snake.

*3. *Rana erythræa* (Schleg.).

*4. *Callula baleata* (Müll.).

5. *Bufo claviger*, Ptrs.

*6. *Ichthyophis glutinosus* (L.).

BIBLIOGRAPHICAL NOTICES.

A History of British Birds. By WILLIAM YARRELL, V.P.L.S., F.Z.S. Fourth Edition, revised and enlarged: Vols. I. & II. by ALFRED NEWTON, M.A., F.R.S.; Vols. III. & IV. by HOWARD SAUNDERS, F.L.S., F.Z.S., &c. (Van Voorst.)

OF the works on ornithology which have recently appeared none will be hailed with greater satisfaction than the new edition of Yarrell's 'British Birds,' which has recently been brought to a successful conclusion. The first edition of this standard authority was completed in 1843, a second and third being subsequently issued, the last in 1856: both of them little more than reproductions, with additions, of the original.

In 1871 the publisher, with a due appreciation of the great advance which had been made in ornithological knowledge, determined to bring out a fourth edition of this deservedly popular work, embodying the information subsequently acquired. In these days, however, to edit a work of this nature is no mean task, and requires an ornithologist of the highest ability for its performance. It is not merely a repetition of previous editions, with perhaps an editorial footnote here and there, but a careful revision of the whole that has to be done. Every bird's history has to be brought up to date; the evidence upon which some of the rarer species have been—perhaps too hastily—admitted to a place in the British avifauna has to be carefully weighed, and the claims of numerous aspirants to the honour minutely sifted. Indeed, owing to the numerous importations which now take place, the decision as to whether a bird is a truly wild one or has merely escaped—in other words, whether it reached this country with or without the aid of man—is one of the most unsatisfactory duties that can fall to the lot of an editor. Moreover, the mass of literature that has to be digested, scattered as it is through numerous publications, is enough to appal any but the stoutest heart. That this was not lost sight of is evident from the fact of the work being entrusted to the first-named editor, than whom no one more competent to undertake the task could have been found.

Bearing in mind the systems with which the public have become more or less familiar, we think that to have made violent changes in the arrangement, or in any other material point, would have been attended with risk of diminishing the utility of the work; and we therefore consider that in adhering, in the main, to the sequence of the preceding edition, Prof. Newton exercised a wise discretion. Not that there are no changes; far from it. For instance, the old-fashioned and non-scientific reader will be astonished to find that the Swifts (Cypselidæ) are no longer placed with the Swallows (Hirundinidæ) nor the Golden Oriole with the Thrushes—the former having been removed from the Passeres to the Picariæ, and the latter from the Merulidæ to the Oriolidæ. These and several other changes of a similar nature have been rendered imperatively necessary by the light of modern research. With regard to this

last-named species, it may be mentioned that while the work was passing through the press the first authenticated cases of its breeding in the Isle of Thanet occurred in 1874 and 1875, as recorded in 'The Field' of those years.

The first two volumes include the Accipitres, Passeres, and Picariæ. There are no very great changes in the first Order, but two species of the large Northern Falcons are admitted as British in place of the so-called Gyr-Falcon of former editions; and the Black Kite (*Milvus migrans*) is figured and described as a rare visitant—a great deal of fresh information being added with regard to these and other species. In the Passeres we find the following additions:—*Muscicapa parva*, *Lanius minor*, *Turdus atrigularis*, *Acrocephalus aquaticus*, *Anthus spipoletta* and *A. campestris*, *Melanocorypha sibirica*, *Euspiza melanocephala*, *Emberiza rustica* and *E. pusilla*, *Serinus hortulanus*, and *Pyrrhula erythrina*: all upon evidence that cannot be disputed, besides additional matter concerning many others. Not the least startling feature is the amalgamation of the Black Crow (*C. corone*) and Hooded Crow (*C. cornix*) into one species, regarding which much diversity of opinion exists in ornithological circles. Another is the elimination from the British list of the Black Woodpecker (*Picus martius*) in default of any satisfactory evidence of the occurrence of that species in the British Islands.

When these two volumes had been finished, Professor Newton was compelled by circumstances to relinquish the editorship; the somewhat invidious task of succeeding such an author being, with becoming public spirit, undertaken by Mr. Howard Saunders, whose name has long been specially connected with the Laridæ; and here, again, the publisher is to be congratulated on having secured the services of so able an ornithologist. The two volumes under his charge—commencing with the Columbidæ and ending with the Anseres—comprise some extremely interesting additions to the British list. Amongst them may be noticed the Sand-Grouse (*Syrrhaptes paradoxus*), whose irruptions into these islands in 1859 and 1863 must still be fresh in the memory of all who are interested in birds; the Great Black-headed Gull (*Larus ichthyaëtus*); the Sooty Shearwater (*Puffinus fuliginosus*); the Flamingo (*Phœnicopterus roseus*), whose strange manner of nesting is depicted in the woodcut at the head of the article; and the Snow-Goose (*Chen hyperboreus*). As an instance of the increase of our knowledge it may be observed that at the date of the last edition the nidification of the Black-winged Stilt (*Himantopus candidus*) was so imperfectly known that Hewitson only tells us that this bird "lays its eggs upon the ground," while doubting that it lays as many as four; and Yarrell does not even commit himself to the former assertion. Its nesting is now fully described, and, curiously enough, it seems that, contrary to the habits of its neighbour the Avocet, and of the Plovers generally, which lay their eggs in a hollow, this bird sometimes, although not usually, builds a raised nest—a miniature Flamingo's in fact—a habit rendered necessary, we imagine, by the situation selected, on the mud by the margins of lakes.

Amongst the birds which are no longer to be found in this work

are the Virginian Colin (*Ortyx virginianus*) and the Barbary Partridge (*Caccabis petrosa*), both of them introduced species which have failed to establish themselves in this country. Any one who reads between the lines can see that Mr. Saunders, from his personal knowledge of its habits, is sceptical as to the genuineness of the recorded occurrences of the Andalusian Hemipode, a species not given to wandering, not found in Malta or France, and so restricted in its habitat that even in Spain and Sicily it is only found in certain southern districts. The so-called "Sabine's Snipe" is now generally regarded as a melanic variety, and has been expunged from the list, although the beautiful original woodcut, remarkable even amongst others for its execution, has been retained as a tailpiece.

A new illustration is given of the Rosy or Cuneate-tailed Gull; and there is also one to show the adult plumage of the Pomatorhine Skua, only the immature stage having previously been figured. The Masked Gull (*Larus capistratus*) is no longer considered a valid species, nor does the editor admit the claims of the American Laughing Gull (*L. atricilla*) to a place in the British list. In the article on the Fulmar Petrel it is pointed out, for the first time, that the young birds of the pale form are similar in plumage to the adults, and that the grey birds, which were formerly supposed to represent the intermediate stage, are not the young of the above, but belong to a distinct dark form. The Ringed Guillemot is degraded from its former specific rank; and it is clear that if Mr. Saunders had been writing a book entirely his own, such species (admitted by Yarrell) as the Polish Swan, the Canada, Spur-winged, and Egyptian Geese, and more than one Duck, would have been omitted.

In a short Preface placed at the commencement of the third volume Mr. Saunders gives his reasons for certain changes in the systematic arrangement which he considers to be unavoidable consistently with the present state of our knowledge. In former editions the order Limicolæ was split in two, the præcocial Plovers being separated from the equally præcocial Snipes, Sandpipers, &c. by the Herons &c., whose young are helpless for some time after they are hatched; the Phalaropes were placed next to the Rails, and the whole of the above and some other genera were comprised in one huge impossible Order—Grallatores. The Gulls and Terns, now admitted to be so closely allied to the Limicolæ that it is doubtful whether they ought not to form part of that order, were classed with Ducks &c. as Natatores; and the Petrels, now known to have little in common with the Gulls but a superficial resemblance, were actually placed among the Laridæ! All this is now altered, and, as we believe, very much for the better, although there will doubtless be some grumblers who will not take the trouble to refer to the capital index, and complain that they "never know where to look for a bird now."

The entire work has been so thoroughly well executed that we have no hesitation in stating that it will maintain its place as the standard

book of reference on British birds, alike on the book-shelf of the student and in the library of the country gentleman, for many years to come.

Russian Central Asia. By HENRY LANSDELL, D.D. In two volumes. 8vo. London, 1885.

ZOOLOGISTS will experience much satisfaction in finding in a work, the author of which does not claim to be a naturalist, unexpectedly a source of information which is all the more welcome as it refers to a part of the globe that claims our attention in an unusual degree. We sadly missed in Dr. Lansdell's first work, 'Through Siberia,' information as to the natural productions of that remote region, and could not help feeling that an opportunity had been lost. This is in some measure remedied in this new work on Russian Central Asia. It forms two large volumes, handsomely illustrated with seventy engravings and maps.

The bulk of the work is occupied by the author's record of his journey of 12,000 miles through Western Siberia to Kuldja, thence through the Kirghese steppes to Tashkend, Khokand, and Samarkand. Crossing into Bokhara he travelled to the Oxus, down which he floated 300 miles to Khiva, and then continued by a new route across the land of the Turkomans and north of Merv to Krasnovotsk. As province by province of Russian Central Asia are described, their several faunas and floras are shortly characterized; but the most important part of the information is contained in the appendices at the end of the second volume, which extend to about 150 pages of closely but clearly printed matter.

Concerning the fauna of Russian Turkestan Dr. Lansdell, after pointing out that until within the last thirty years Turkestan was all but unknown to science, gives a brief account of the various naturalists who have proceeded there—amongst whom the first place is very properly given to Professor A. P. Fedchenko, whose work, written in Russian, is unfortunately a closed book to the majority of English naturalists.

Thanks to help which Dr. Lansdell has received, the introductions to the various portions of Fedchenko's collection are translated and supplemented by lists of the species, so that the English reader may obtain a good idea of the fauna and flora of the region traversed. Severtzoff's lists of mammals and birds had already been translated, and to these Dr. Lansdell adds those of reptiles and amphibians, giving here, as also with the mammals and birds, both the vertical and horizontal distribution.

We have next the monograph on Turkestan fishes by K. F. Kessler. In the account of the Mollusks the area is extended beyond Turkestan to the Altai, the Trans-Baikal, Afghanistan, Tibet, Cashmir, North-west Himalayas, and Yun-nan. Five pages are devoted to Arachnida, with 146 species, after which follow the Crustaceans and Coleoptera. At the end of this last order Dr. Lansdell

gives a portion of Solsky's third part, which was not published at the time of that author's death.

The tables on Hymenoptera and Lepidoptera are particularly full, and to each species is added its distribution in other countries and its vertical distribution in Turkestan. M. Alpheraky, of Taganrog, has furnished Dr. Lansdell with a list of 377 species of Lepidoptera he captured in the Kuldja valley, giving the altitude at which each species was taken and the month of capture. The remaining lists contain Neuroptera, Orthoptera, and Vermes.

It should be added that these lists respectively have been revised for the most part by their authors, or, rather, those of them who are living; and Madame Fedchenko, who edited so many of her husband's works after his lamented death, has also revised the tables in their English dress.

A separate appendix is devoted to the flora of Russian Turkestan, and comprises 1234 plants; whilst a third consists of a most valuable bibliography of 700 publications on that region in English, French, German, Russian, and other languages.

Dr. Lansdell has been too successful a traveller to resist long the temptation of invading other regions of the east. We understand that the last sheet of his work had hardly been passed through the press when he started again for Asia Minor; and we have no doubt that this new journey will contribute not only to our information, but also to our collections.

Our Insect Enemies. By Theodore Wood. Small 8vo. London: Society for Promoting Christian Knowledge. 1885.

Mr. Wood has followed up his little book on 'Our Insect Allies,' which we noticed just a year ago, with a similar volume on injurious insects. The view of the real nature of the relations of insects, whether injurious or beneficial, to man, which we indicated as the guiding principle of the author in discussing these matters, is still further developed in his present work, in which he describes the structure and natural history of a select few of those insects whose existence acquires prominence by the mischief they cause to us. The little histories are told in a pleasant style, and in his two books the author has certainly furnished an excellent popular contribution to entomological literature, and one which may serve as a valuable guide in the first steps to a knowledge of the economy of the insect world. The principal mistake he has fallen into is his devoting nearly a quarter of his present volume to the natural history of the Aphides, a subject which, although most interesting to the entomologist, can hardly have its full importance realized by the beginner, while its occupying so much space has evidently led to some other sections of the work being somewhat starved. The volume is illustrated with a good many woodcuts, mostly of pretty good quality.

MISCELLANEOUS.

A Classification of the Sponges. By Professor Sollas, D.Sc.

The Porifera are a distinct phylum (Parazoa) of the animal kingdom, divisible into two classes, namely:—

I. Plethospongiæ (πλῆθος, a crowd).
II. Calcispongiæ.

The Plethospongiæ may be subdivided into three orders:—

i. Hexactinellidæ.
ii. Demospongiæ (δῆμος, the common people).
iii. Myxospongiæ.

The Demospongiæ embrace the great majority of sponges, and are divisible into two suborders, the Monaxonidæ and Tetractinellidæ. The horny sponges may be added as a third suborder, the Cerospongiæ; but since they are probably of polyphyletic origin, derived from different families of the Monaxonidæ, it is open as an alternative to distribute them among the families of that group.

On the Pelagic Annelides of the Bay of Algiers. By M. C. Viguier.

From November 1884 to June 1885 I made daily investigations at the entrance of the port of Algiers, for the purpose of studying the pelagic fauna of the bay, and especially the Annelida.

It is well known that the pelagic Annelida are divided into several groups. Some, like the Heteronereids or Syllidiæ, without alternate generations, only belong to the surface-fauna during the short period of sexual activity. Others are pelagic during their whole existence; but this existence, which is very short, only represents the same period of activity as in the preceding group; they are the sexual stolons of the Syllidiæ with alternate generations, the *Polybostrichi* and *Saccoreneides*. Lastly, a third group includes essentially pelagic creatures which have never been observed except at the surface, and appear to be completely adapted for that mode of life. From my observations all these organisms belong to the two families Alciopiæ and Phyllodociæ, for we can only regard as very greatly modified Phyllodociæ, on the one hand *Tomopteris*, and on the other the curious *Sagittellæ*. Considering the close affinity which exists between the families Alciopiæ and Phyllodociæ, which were formerly confounded, one might be surprised that *all* the animals composing the former being pelagic, there was only known with certainty *a single* pelagic Phyllodocian, namely *Hydrophanes* of Claparède. For good reasons I do not mention *Lopadorhynchus*, Grube. Three other types of this family had, however, been seen,

as long ago as 1879, by M. Greeff, at the Canaries; but an imperfect study of them led that naturalist to refer two of them to the Syllidiæ and one to the Lycoridiæ. I have again found not only Claparède's *Hydrophanes*, but also Greeff's three types; and, besides these, two new genera, which also very evidently belong to the Phyllodociæ. This makes a total of six genera, presenting a regular gradation in the concentration of the postcephalic segments and the arrangement of their appendages.

Among the Alciopiæ I have only met with two new species.

As to the animals the like of which inhabit the surface only during the larval life, and descend to the bottom during the rest of their existence, it becomes difficult, when one meets with them in a certain state of development, to say whether they are examples belated in their pelagic existence, but which finally dwell at the bottom, or organisms which have definitively adapted themselves to conditions of existence quite different from those of the rest of the family. The question can hardly be solved when we do not find well-developed sexual products. It is in this doubtful class that I shall range *Ophryotrocha*, Claparède, although the Genevese naturalist saw it loaded with ova. In it I shall also place a *Polynoë*, to which I for the present abstain from giving a name, but which appears to me to present a real adaptation to pelagic life.

The following is the complete list of the species observed:—

Aphroditeæ:—*Polynoë*, sp.?

Lumbriconereideæ:—*Ophryotrocha puerilis*, Clap. & Meczn.

Syllidiæ:—A. Without alternate generations: *Exogone gemmifera*, Pag.; *Sphærosyllis pirifera*, Clap.; *S. hystrix*, Clap.; *Grubea limbata*, Clap.

B. With alternate generations: *Autolytus*?, *Virchowia clavata*, Langerh.; and several undetermined Sacconereids.

Phyllodociæ:—*Pelagobia longocirrata*, Greeff; *Maupasia cæca*, C. Vig.; *Hydrophanes Krohnii*, Clap.; *Pontodora pelagica*, Greeff; *Ioda microceros*, C. Vig.; *Phalacrophorus pictus*, Greeff.

Alciopiæ:—*Asterope candida*, Clap.; *Alciope Cantrainii*, Clap.; *A. microcephala*, C. Vig.; *Vanadis heterochæta*, C. Vig.; *Rhynchonerella capitata*, Greeff.

Tomopteriæ:—*Tomopteris Kefersteinii*, Greeff; *Sagittella Kowalewskyi*, N. Wagn.

It is to be remarked that of these twenty species, four are new, five have hitherto only been noticed at the Canaries by M. Greeff, and one at Madeira by M. Langerhans.—*Comptes Rendus*, Sept. 7, 1885, p. 578.

On the Organization of Truncatella. By M. A. Vayssière.

The author, somewhat erroneously, says that the genus *Truncatella* has hitherto been generally regarded as a Pulmonate Gasteropod, and the only writers to whom he refers as holding a contrary

opinion are Lowe and Clark. But most recent naturalists place *Truncatella* among the Branchiferous Mollusca. The author has obtained specimens of *Truncatella truncatula* from the Gulf of Lyons, and describes its general organization and especially its mode of respiration.

By carefully crushing the shell and then tearing to pieces the anterior part of the animal the author displayed an elongated organ, composed of from twelve to fifteen triangular lamellæ covered with long vibratile cilia. This organ, which is a true *branchia*, is attached to the roof of a large respiratory cavity observed at the dorsal surface of the mollusk. It is placed transversely to the axis of the body, and its lamellæ can be moved by the animal simultaneously or separately for the renewal of the surrounding water. The mollusk can store up a certain quantity of water in its respiratory cavity, which enables the animals to remain a long time out of the water.

The author describes the principal points observed by him in the anatomy of *Truncatella*. In front of the buccal bulb there is a long proboscis, which may be employed to assist in locomotion, although the foot is usually the sole organ of progression. In the buccal bulb there are two horny jaws, and between them a very long radula, of which the dental formula is 2, 1, 1, 1, 2. The stomach is also furnished with horny pieces serving to complete the trituration of the food. The liver occupies the truncated extremity of the shell (about the last two whorls) and is large; it discharges itself by a single duct, which opens into the intestine just behind the stomach.

The genital gland (male or female) is placed immediately in front of the liver, to which it always adheres more or less. The excretory duct (deferent canal or oviduct) runs along the right side of the body, following the intestine, and opens into the respiratory cavity near the anus; in the male it terminates in a long, cylindrical, unarmed penis. More or less enveloping the intestine and genital duct are various glands (the organ of Bojanus and prostate or albumen-gland); but these could not be separated on account of the small size of the animals.

The nervous system consists of an œsophageal collar with two voluminous centres placed above the œsophagus and almost joined together, the cerebroid ganglia; two inferior or pedal ganglia, nearly as large as the preceding, to which they are attached by two connexions on each side, and to each other by a long commissure; and four much smaller visceral ganglia, placed two and two at the sides of the œsophagus and only united to the supra-œsophageal centres, complete the collar. The visceral ganglia are united by two long connexions with a fifth centre, the viscero-genital ganglion, which is buried in the glandular mass surrounding the intestine. Besides these nine centres there are the buccal ganglia, placed at the posterior part of the bulb, below the origin of the œsophagus. The eyes

occupy the basilar region of the tentacles; the otocysts rest upon the pedal ganglia and are united to the cerebroid ganglia by two very delicate nerves. Each otocyst contains a single large spherical otolith.

The author, in conclusion, notices a singular Vorticellidan Infusorian of the genus *Scyphidia*, which occurred on the extremity of the copulatory organ of several of his *Truncatellæ*. The species of this genus have hitherto been known only from fresh water; to this marine species he gives the name of *Scyphidia Fischeri*. It has a cylindrical body, slightly attenuated above; its peristome is not much reflexed; and it has a broad and very thick foot, enabling it to adhere strongly to the bodies on which it occurs. Its surface is slightly striated in the direction of its length. These Infusoria move very slowly.—*Comptes Rendus*, Sept. 7, 1885, p. 575.

On the Development of Aurelia aurita *and* Cotylorhiza borbonica. By Dr. A. Götte.

The first segmentations of the ovum produce neither exclusively equal nor exclusively unequal blastomeres, but the two occur promiscuously together.

A *cœlogastrula* with a narrower or wider archenteron and a prostoma always exists; but, so far as I can see, is *never produced by invagination*. There is rather in the cœloblastula a perfectly irregular migration of endodermal cells into the blastocœloma, so that there originates from it a *sterrogastrula* of which the endoderm becomes secondarily excavated (archenteron) and breaks out (prostoma). By the closure of the prostoma and the development of cilia on the ectoderm the cœlogastrula is converted into the larva (planula), which swims along with the vertical (aboral) pole forward and attaches itself thereby.

Before or after the attachment a sacciform *invagination of the ectoderm* is produced at the prostomial end (Kowalevsky), and this becomes the *persistent ectodermal œsophagus*, which breaks through into the stomach. At the same time the endoderm becomes sacculated in the form of the finger of a glove at two opposite sides between the œsophagus and the ectoderm; these first two *gastral sacs* are continued downwards like grooves in the wall of the stomach, two gastral folds being produced there in each case. Between the two primary gastral sacs a new but broader gastral sac is formed on each side; and the four sacs surrounding the œsophagus at the same time by their contiguity form four *septa*, which are continued downwards into the gastral folds.

The *tentacles* grow forth above the gastral sacs, at first one over each of the primary, and then three over each of the secondary sacs; of these latter (3+3) tentacles the four outer ones push forth each in a septal plane. It is only at a later period that the four quadrants become equal in their dimensions and in number of tentacles.

The so-called *muscles* of the Scyphistomes originate neither from the endoderm nor from the outer wall of the cup, but from funnel-shaped invaginations of the perioral ectoderm into the interior of the septa and folds, into which they extend themselves like tubes and remain hollow. The *orifices* of these tubes are still present on the young strobila, so that the *first Ephyra* appears as the original oral segment of the Scyphistoma.

Besides the strobila-formation a regular budding of the Scyphistoma occurs; in *Cotylorhiza* I frequently saw the bud grow forth with the foot foremost, so that its last connexion with the parent animal was at the mouth.

From these observations, made throughout on intact living objects and upon the finest sections, the following deductions may be drawn:—

a. The *cœlogastrula* of the Scyphomedusæ investigated is a *secondary embryonic form,* as the gastrulation is effected by *the immigration of the endoderm into the cavity of the cœloblastula.*

b. The *Scyphistoma is a perfect Anthozoon.* In favour of the close relationship of these two forms only the gastral folds could hitherto be cited; but these also occur, although imperfectly, in Hydroids, and therefore were not thoroughly decisive as to this relationship. The *invagination of the ectodermal œsophagus observed by me and the gastral sacs and septa surrounding it,* however, stamp the Scyphistoma as a true Anthozoon.

c. As the strobila is produced only by simple division, and the Ephyra originates under certain circumstances, even without division, directly from the Scyphistoma, every ground for the assumption of an alternation of generations in *Aurelia* and *Cotylorhiza* is removed. *The Ephyra, and consequently the Scyphomedusa, is a metamorphosed Scyphistoma or Anthozoon, just as the Hydroid Medusa is a metamorphosed Hydroid Polyp.—Zoologischer Anzeiger*, no. 205, Oct. 5, 1885, p. 554.

On the Original Fundamental Numbers of Medusæ and Echinoderms. By Wilhelm Haacke.

Häckel founds his genealogical tree of the Echinodermata, in which he adopts the Asterida as the ancestors of the other Echinodermata, upon the circumstance that in the Asterida there are species with a variable number of arms and others with a constantly augmented number, while the same thing does not occur in the other Echinodermata, those "worshippers of the number five," with the exception of the Ophiuræ, which, according to Häckel, are nearly related to the Stellerida.

I have now to state that I have found four quaternary examples and one sextenary one in a South-Australian species of the Echinid genus *Amblypneustes.* Whether similar specimens have been

observed in other species of Echinida or among the Holothuriæ, Crinoidea, and Blastoidea I do not know; our textbooks and manuals give no information upon such questions. But, at any rate, my specimens prove that the privilege of a variable number of paramezes is not enjoyed by the Asterida alone.

What conclusions are to be drawn from my discovery with regard to the genealogical tree of the Echinodermata, is a question which I only wish to raise here; but my communication of it gives me the opportunity of calling attention to the insecure foundation of the above inference of Häckel's.

With regard to the Medusæ we are indebted to Häckel for the demonstration of the original fundamental number of four, from which the other fundamental numbers which occur among the Medusæ are to be derived; and the question therefore presses itself upon us whether the fundamental number five, which prevails among the Echinodermata, is not also the original number.

In my memoir upon *Hydra* ('Jenaische Zeitschrift,' 1880) I have endeavoured to give an explanation of the original tetramerism of the Medusæ, which I may here confirm by an observation made some years ago at Kiel. I must refer to the above-mentioned memoir, the most essential results of which have also been obtained by other naturalists, and have here only to indicate that the Medusa-bud of *Sarsia tubulosa* is so placed with regard to the parent polyp of *Syncoryne Sarsii* that one of the median planes of the young Medusa fixed by the tentacles of the bud stands perpendicular to the principal axis of the parent polyp, while the latter coincides with the other median plane of the bud.

The fundamental number of the quaternary Medusæ, at least of the Craspedota, is therefore causally conditioned by the lateral budding of the Medusa on the polyp; and it is therefore a question whether something analogous cannot be demonstrated in the case of the Echinodermata also, although in them there can of course be no question of lateral budding.

In any case the question whether pentamerism is or is not something primordial in the Echinodermata is still an open one; with reference to the undoubtedly original tetramerism of the Medusæ one might feel inclined to answer it affirmatively.—*Zoologischer Anzeiger*, no. 203, August 31, 1885, p. 505.

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BIBLIOGRAPHICAL NOTICES.

MISCELLANEOUS.

⁂ It is requested that all Communications for this Work may be addressed, post-paid, to the Care of Messrs. Taylor and Francis, Printing Office, Red Lion Court, Fleet Street, London.

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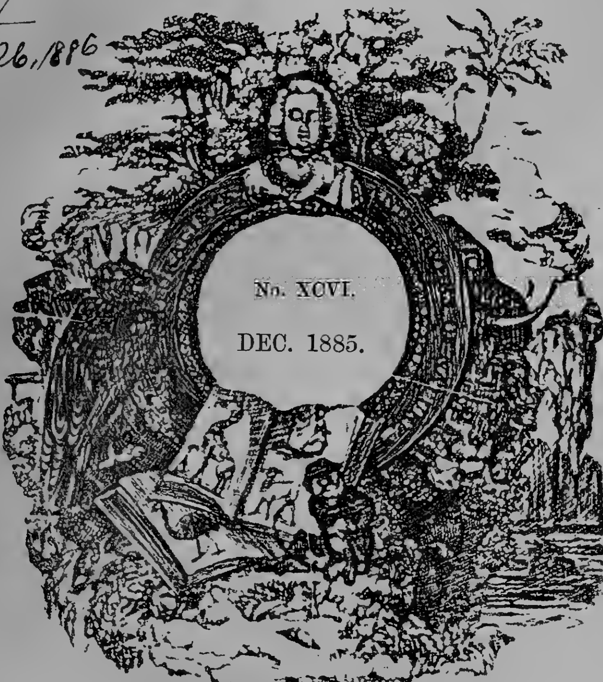

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[FIFTH SERIES.]

No. 96. DECEMBER 1885.

XXXVIII.—*The* Victorella pavida *of Saville Kent.* By E. C. Bousfield, L.R.C.P., Lond.

[Plate XII. figs. 1–3.]

Having recently been so fortunate as to meet with a considerable supply of this beautiful and interesting polyzoon, I propose in the following notes to give a description of it, with special reference to the observations of the naturalist who first found it and described it at some length in the 'Quarterly Journal of Microscopical Science' (N. S. vol. x. p. 34, with pl. iv.). As my own observations differ in one or two essential points from Mr. Kent's, I append the systematic description which he formulated:—

"Family **Homodiætidæ.**

"*Victorella pavida.*

"Polypidom minute, confervoid, adherent or semierect, irregularly branched. Tentacles eight in number; no gizzard. Inhabiting brackish water. Parasitic on the polypary of *Cordylophora lacustris.*"

Mr. Hincks, in his 'Marine Polyzoa,' describes the *Victorella*, but with important differences from the statements of Mr. Kent, and, in fact, by combining the two accounts it is possible to arrive at conclusions somewhat approaching the truth. Mr. Hincks, however, had not, I believe, the opportunity

of examining fresh specimens, and his description is but a portion of what has to be said regarding *Victorella*.

I first met with the polyzoon in question last spring, at which time the zooids were solitary, and semi-repent, colourless, and in shape much like a violin with a straight elongated neck. Not being aware of the observations of Messrs. Kent and Hincks, I communicated particulars and sketches to one or two gentlemen who had special knowledge of the subject; and Mr. Pennington, of Bolton, first suggested the identity of my find with *Victorella*, though its solitary condition and the remarkable anatomical divergences from published descriptions rendered the identification somewhat doubtful.

I failed to find any further specimens until September, when I came into possession of a considerable quantity, and the results of my examination will be embodied in the following notes.

The polypidom consists of a series of slender yellow or brownish tubes, on which at intervals are situated swellings (fig. 1, *a*, *b*, *c*), in each of which a zooid is developed in the ordinary way from an enlargement of the *funiculus* (fig. 1, *d*) or continuous protoplasmic cord which runs through the whole of the tubes of which the colony is composed. From each swelling arise two branches at right angles (fig. 1), and by the growth of these branches and the development of zoœcia, from which again other branches arise, the growth of the colony continues, always branching in a rectangular direction, so that a matted mass results. The zooids developed at the nodal points vary widely in dimensions; I have examined some which have reached $\frac{1}{10}$ in. in height, whilst others were not more than $\frac{1}{40}$ in. At the terminations of the branches are to be found, as a rule, the largest specimens, and in the case of these individuals the cell is of much more uniform diameter than in the smaller ones, so that the whole animal is contained within it even when retracted.

Taking one of these larger specimens as a type, the following appearances present themselves.

The tentacles, eight in number, are arranged around the mouth of the animal. They are hollow (fig. 2, *g*), and of almost the same diameter throughout, with the usual row of cilia on either side. These cilia, however, do not form a continuous series, but fringe only the adjacent sides of the tentacles, their place being taken at the apex by a tuft of stiff but very slender setæ (fig. 3, *h*) which are devoid of movement. These setæ extend in a linear series down the outer side of the tentacles, and specially long ones are also found around the ring formed by the fusion of the bases of the latter.

The tentacular crown rests upon the upper part of the pharynx (fig. 2, *a*, *b*, fig. 3, *a*). This is a pyramidal sac with thick walls, formed of radiating prismatic fibres, by which it is rendered capable of great and very rapid dilatation. The upper margin is thinned out to form the circular lip (fig. 2, *b*), which contains a sphincter muscle, and just below a deep constriction runs round the outer wall (fig. 2, *c*). This constriction, into which the cavities of the tentacles open, is in free communication with the perivisceral space below, and this is the only trace of a vascular system which I have been able to discover. When contracted the whole of the cavity within the pharynx, except a small triangular ciliated space within the mouth, is obliterated, and three radiating folds take its place. At its termination the pharynx communicates with the gizzard (fig. 3, *b*), a slight sphincter-like ring marking the separation. The possession of a gizzard is denied to *Victorella* by Mr. Kent, but its existence is not difficult to make out with a power of 200 diameters, whilst it is very easy with anything approaching 400. The point is, moreover, put beyond dispute by some instantaneous photographs which I have succeeded in taking with an exposure of $\frac{1}{4}$ second or thereabouts to magnesium light*.

In these photographs the double sphincter, the upper part belonging to the gizzard and the lower to the stomach, is most clearly shown (fig. 3, *c*).

The gizzard is simply a thin-walled sac, without cilia, but faintly striated transversely, and showing under a high power traces of the same honeycomb arrangement as that presented by the bases of the prismatic fibres of the pharynx. It is separated from the stomach by the sphincters just referred to, and between the two a slight groove exists, marking clearly the point of separation.

The stomach (fig. 3, *d*) is a long thick-walled tube, the lower part of which is of a deep yellowish-brown colour, the walls showing numerous granules and small oil-globules. The lower portion of the stomach is continuous by its outer wall with the funiculus (fig. 3, *i*), which is colourless, and

* These photographs were taken on the Autotype Company's Challenge plates, with a camera extended to 8 feet, in order to obtain depth by the use of a low power. In conjunction with my cousin, Mr. E. Shepherd, I am making a series of experiments in this direction, and the results so far obtained hold out great promise of future success. I look forward chiefly to being able to obtain accurate outlines of the principal features, which may, if necessary, be worked up by hand, so as to get rid of the inexactitude which, to some extent, must always affect the most finished drawings made by hand and eye alone from living and moving objects.

passes down to end in an enlargement attached to the wall of the tube, which is continuous below with the remainder of the general cord.

The intestine (fig. 3, *e*) arises from the stomach at a point opposite to the entrance or cardiac orifice. At the point where it commences there is within the stomach a semilunar valve-like flap on the gastric wall, and this, which forms a pylorus, is ciliated, unlike any other portion of the stomach. At this point a pellet of food may be seen to be constantly whirling round in a manner strongly suggestive of the action of the pellet-forming organ of *Melicerta ringens*.

The walls of the intestine are thin, and its upper portion is surrounded by a mass of granular protoplasmic material. The anus is not, as generally stated, situated immediately below the tentacles. The intestine terminates halfway between this point and the stomach (fig. 3, *f*), and for the remainder of the distance a hollow muscular tube passes upward, and ends at the spot usually assigned to the anal orifice (fig. 3, *g*).

The process of defæcation is accomplished as follows:— The current caused by the reversed peristaltic action of the stomach drives the flap before spoken of against the cardiac orifice, thus preventing regurgitation, and the pyloric orifice opening, the matter about to be rejected is propelled into the intestine, the pyloric sphincter closing the opening behind it. The intestine is then drawn up by the muscular tube attached round the anus, until this last is beyond the membrane which closes the cell, and the intestine thereupon, and only thereupon, contracts and expels its contents. The anus then sinks down to its normal position, until the time arrives for a repetition of the process. This arrangement is so remarkable that I am glad to be corroborated by the authority of one so competent as Prof. Allman, who writes:—"Your remark regarding the termination of the intestinal tube and its action in the expulsion of the ejectamenta is interesting, and now that you have called my attention to it, I think I have noticed the same phenomenon in other species."

The whole of the organs are invested by a delicate membrane, which is continued upwards to a point just beyond the commencement of the tentacles (fig. 2, *e*), whence it is reflected on to the inner surface of the tube of the animal. The tube is composed of a transparent homogeneous substance, the lower portion being rigid and the upper flexible. The rigid portion is strengthened at intervals by transverse bars of a transparent material, free at either end. The flexible portion is dilated near its centre, and contracts again slightly

towards the point where it joins the operculum (fig. 3, *k*). This is a tube composed of a very delicate membrane, developed independently in a mass of protoplasm at the upper part of the embryonic cell. It is generally described as composed of setæ, around which the membrane is stretched; but, whilst I am not prepared to contradict the statements of such authorities as Professor Allman and Mr. Pennington, not to mention other writers on the subject, I am convinced, after most careful observation directed to this special point, that nothing of the sort exists in *Victorella*, nor can I find any trace of setæ with the highest power which I have found it possible to use, about 500 diameters. When seen from above the appearance is that of a circular opening, with zigzag margin, no trace of thickening or unevenness being anywhere visible. I have also examined specimens of *Bowerbankia imbricata* and of *Cylindrœcium* without being able to trace the setæ either with direct or dark-ground illumination, though the very delicate setæ on the tentacles were plainly apparent. There are no muscles attached to the operculum; but the flexible portion of the tube below it is retracted by a powerful muscle, whose fibres are striated, and which is attached below to the rigid portion of the tube. There is also a muscle by means of which the alimentary canal is retracted, and to the base of each tentacle is attached a narrow band of striated fibre (fig. 2, *d*), by which, in concert with its fellows, the tentacular ring is withdrawn, and the action of one or more is able to draw the crown to one side or the other. There are also small muscles by means of which the animal is able to rotate upon its axis. For the sake of clearness these muscles are omitted in the drawing.

In some cases a small projection may be seen upon the side of the tube near its centre. This is the germ of a future zooid, so that, in addition to the growth by enlargements arising in the course of the stolon, each terminal zooid at least may give origin to another colony, for the zooid thus developed forms a stolon in the usual way. It should have been stated, in speaking of the general stolon, that beyond each zoœcium there exists a septum in the course of the stolon, through which the funiculus runs, having on either side of the septum a conical enlargement, the bases of the two being in contact.

The nodal zooids are, as has been stated, generally much smaller than the terminal and devoid of colour; the tentacles and stomach are also, as a rule, much less developed. Anatomically, however, there is no difference between them.

The interest attaching to this polyzoon no doubt centres in

the fact that we have here a form intimately allied to, if not identical with, some marine forms, and differing widely from the freshwater types, but which yet with its host appears to find itself perfectly at home in fresh water. Mr. Shepherd has, since seeing my specimens, found it in the Regent's Canal at Maida Vale; and I have found it in the Surrey Canal, unaccompanied by any other marine type, or even one found largely in brackish water, except *Pleurosigma.*

The small number of tentacles, their setigerous character, the complete extrusion of the polypide, the absence of epistome, and the striated muscular fibres are distinctly different from the freshwater type, and are constant characteristics of the marine type. Much remains to be done before the conditions under which this and similar transfers of marine forms to freshwater habitats are understood.

It will be seen that my observations differ from Mr. Kent's as to the character of the polypidom of *Victorella*, the presence of the gizzard, and the nature of the operculum, while, probably from not using sufficient magnification, he did not make out the setæ upon the tentacles and apparently did not see the typical form of *Victorella* at all.

In conclusion, I have to acknowledge much kindness received from Prof. Allman and Mr. Pennington (whose work on the British Polyzoa is, I believe, about to appear). The latter gentleman relegates *Victorella* to the family Cylindrœciidæ, and has kindly drawn up the following diagnosis:—

Genus Victorella.

Characters as *Cylindrœcium*, but polypides transparent and having a gizzard. Tentacles eight.

Victorella pavida, S. Kent.

Stem repent, slender, orange-coloured during life, transparent after death; clavate enlargements wide apart. Zoœcia with upper portion erect, cylindrical, transparent, slender. Below adherent and dilated, forming part of the stolonic expansions.

Hab. Brackish and fresh water, on *Cordylophora lacustris*, whose migrations it follows.

EXPLANATION OF PLATE XII. Figs. 1–3.

Fig. 1. Portion of stolon at growing end, showing the lateral branches and young zooids. *a*, zooid extended; *b*, zooid developing; *c*, embryonic zooid at end of branch; *d*, funiculus.

Fig. 2. Optical longitudinal section through tentacular ring and adjacent parts. *a*, wall of pharynx; *b*, thinned margin of same, reflected to enclose *c*, circular sinus, which is continued into *g*, canal of tentacle; *d*, striated retractor muscle of tentacle; *e*, perivisceral membrane, reflected over base of tentacle; *f*, operculum.

Fig. 3. A fully-developed but asexual zooid. *a*, cavity of pharynx; *b*, gizzard; *c*, sphincters of gizzard and stomach; *d*, stomach; *e*, intestine; *f*, termination of intestine (*i. e.* anus); *g*, termination of muscular tube attached round anus; *h*, tufts of setæ crowning tentacles; *i*, funiculus; *k*, operculnm.

XXXIX.—*Diagnoses of the new Species of* Galatheidea *collected during the 'Challenger' Expedition.* By J. R. Henderson, M.B., F.L.S.

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The present paper contains brief notices of the new species of Galatheidea obtained during the cruise of H.M.S. 'Challenger.' As some time has elapsed since the return of the expedition in 1876, a number of the species then new to science have been retaken and described elsewhere. This is especially the case as regards the group treated of, and four deep-water genera well represented in the collection, viz. *Galacantha*, *Elasmonotus*, *Diptychus*, and *Ptychogaster*, come under this category. I am indebted to the courtesy of M. Alphonse Milne-Edwards for the opportunity of examining his types from the 'Blake' and the recent French expeditions.

Galathea, Fabr.

Galathea pusilla, n. sp.

Rostrum triangular, nearly twice the length of the ocular peduncles, with a prominent tooth on either side of the base, and a minute one towards the apex (the latter is occasionally absent). Carapace smooth and glabrous, the striæ not numerous, the lateral borders each with seven or eight spines; gastric region with two small spines on either side of the median line. Chelipedes long and slender, the meral, carpal, and propodal joints each with three rows of spinules; fingers parallel and finely toothed. Ambulatory limbs slender and compressed, with a few spinules especially on the meral joints.

Length of body (in a ♂) 10 millim.; length of chelipedes 11 millim.

Loc. Station 163 [off the New South Wales coast], 120 fathoms.

Galathea inconspicua, n. sp.

Rostrum narrow, not twice the length of the ocular peduncles, slightly excavated above towards the base; lateral borders with four teeth, which diminish in size as they pass forwards, the central point very long and acute. Carapace glabrous, the striæ fairly numerous and slightly raised; gastric region swollen, armed with six small spines, lateral border eight-spined. Chelipedes and ambulatory limbs wanting in the only specimen.

Length of body (in a ♂) 8 millim.; breadth of carapace 3 millim.

Loc. Station 194 [off Banda Is.], 360 fathoms.

Munida, Leach.

Munida spinosa, n. sp.

Rostrum twice the length of the supraocular spines, the latter nearly twice the length of the ocular peduncles. Carapace considerably narrowed in front, the lateral margins with seven large spines; gastric region with from six to ten spines in front, a few spinules on the hepatic and branchial areas. Chelipedes robust, slightly pubescent, the propodal, carpal, and meral joints with several rows of large spines. Carpi and meri of the ambulatory limbs with their anterior borders spiny. The second abdominal segment with a row of from six to ten large spines.

Length of body (of adult ♂) 56 millim.; length of chelipedes 76 millim.

Loc. Station 145 [off Prince Edward Island], 310 fathoms; Station 320 [off the mouth of the Rio de la Plata], 600 fathoms.

Munida Normani, n. sp.

Rostrum half as long again as the supraocular spines, the latter about equal in length to the ocular peduncles. Carapace with two spines on the posterior border, a transverse row of spines on the cardiac area, and a row of spines on either branchial region near the borders of the cardiac area, also two spines on the gastric area; lateral borders of the carapace with about six spines. Chelipedes cylindrical, covered with slightly imbricated scales, the inner surface of the joints (especially of the meri) furnished with spines, the digits long,

narrow, and slightly upturned. Meral joints of the ambulatory limbs fringed anteriorly by a row of spines and long hairs. The second, third, and fourth abdominal segments with four spines each (the two central of which are largest), the fourth having in addition a single median spine placed behind the others.

Length of body (of adult ♂) 39 millim.; length of chelipedes 57 millim.

Loc. Station 173 [south of the Fiji Is.], 300 fathoms.

Munida squamosa, n. sp.

A species allied to *M. Normani*, but differing from it in the following respects:—The rostrum slender, slightly exceeding the ocular peduncles, the supraocular spines nearly the length of the rostrum. Carapace with a mesial spine on the cardiac region, and one on either side of this near the line of junction of the branchial and cardiac areas (situated in the former area). The chelipedes long, slender, and cylindrical, clothed with imbricated ciliated scales. The ambulatory limbs also covered with scales, the tarsal joints contorted.

Length of body (of adult ♂) 52 millim.; length of chelipedes 81 millim.

Loc. Station 219 [north of the Admiralty Is.], 150 fathoms.

Munida granulata, n. sp.

The surface of this species is everywhere covered by granulations, which in some parts show a tendency to run into minute spinules or scales; it is also slightly pubescent. Rostrum short, in length equalling the ocular peduncles, but more than double the length of the supraocular spines. The eyes remarkably compressed. Carapace with a row of small spines on the posterior border, the cardiac area with three spines arranged mesially; gastric region with a central spine and two placed anteriorly, a few small spines on the posterior branchial region. Chelipedes long, slender, and cylindrical, almost naked, the digits long and curved. The ambulatory limbs also long and slender, with the tarsi contorted. The second and third abdominal segments with a double row of spines, the fourth with a single row and raised median protuberance behind.

Length of body (of adult ♂) 33 millim.; length of chelipedes 64 millim.

Loc. Station 173 [south of the Fiji Is.], 300 fathoms.

Munida scabra, n. sp.

Allied to *M. granulata*, but differing from it in the following

respects:—The granulations on the chelipedes and ambulatory limbs are in *M. scabra* superseded by small scales, those on the carapace by minute spinules. The rostrum in this species is comparatively shorter, and the supraocular spines separated from one another by a wider interval than in *M. granulata*. The arrangement of spines is similar to that in the last (with the exception that there is only a single one in the centre of the posterior border of the carapace), but they are everywhere more strongly developed. Finally, the marking of the last two abdominal segments is very different in the two species: in *M. granulata* it consists of small ciliated scales, whereas in *M. scabra* these are represented by raised concentric lines passing across the segment.

Length of body (of adult ♂) 39 millim.; length of chelipedes 63 millim.

Loc. Station 192 [off the Ki Is.], 129 fathoms.

Munida proxima, n. sp.

This comes nearest to *M. scabra*, but is, however, a smaller species. The rostrum is shorter, the spinules on the carapace are more strongly developed, there is no central spine on the gastric region, and that on the centre of the posterior border is wanting. The chelipedes are longer and narrower, but clothed also with minute scales; the digits are long and straight.

Length of body (of adult ♀) 26 millim.; length of chelipedes 44 millim.

Loc. Station 219 [north of the Admiralty Is.], 150 fathoms.

Munida vitiensis, n. sp.

Rostrum nearly twice the length of the supraocular spines, the latter equalling the ocular peduncles. Carapace furnished in front with a row of from ten to twelve spines (the two immediately behind the supraocular spines being larger than the others), the branchial regions with three small spines; lateral margins with about seven spines. Chelipedes short and robust, furnished with hairs and spines, the latter in three rows. Ambulatory limbs short, the meral, carpal, and propodal joints spiny (the propodi with the spines on the inferior border). The second abdominal segment with numerous small spines.

Length of body (of ♀ with ova) 31 millim.; length of chelipedes 28 millim.

Loc. Station 173 [south of the Fiji Is.], 300 fathoms.

Munida militaris, n. sp.

Allied to *M. miles*, A. Milne-Edwards. It is, however, a

smaller species; the carapace is shorter and narrows posteriorly, the gastric region is flatter, and the lateral borders are furnished with about seven spines. The gastric spinules are arranged as in *M. miles.* The chelipedes are short and robust, the principal joints with spines arranged in three rows; the fingers are in contact throughout. The second abdominal segment is alone armed with spines.

Length of body (of a ♂) 33 millim.; length of chelipedes 28 millim.

Loc. Station 173 [south of the Fiji Is.], 300 fathoms; Station 192 [off the Ki Is.], 129 fathoms; Amboyna, 100 fathoms. Station 200 [off the Philippines], 255 fathoms.

Munida inornata, n. sp.

Allied to *M. miles* and *M. constricta*, A. M.-E. Rostrum more than twice the length of the ocular peduncles, the supraocular spines very short (about half the length of the ocular peduncles) and placed close together. Carapace unarmed, with the exception of very minute spines on the lateral borders and a row on the anterior gastric region (of which the two behind the supraocular spines are largest). Chelipedes in the male long, narrow, and slender, very sparingly armed with spines, but clothed with imbricated scales. Second abdominal segment with two very minute spines hardly visible to the naked eye.

Length of body (of a ♂) 26 millim.; length of chelipedes 39 millim.

Loc. Station 219 [off the Admiralty Is.], 150 fathoms.

Munida sancti-pauli, n. sp.

A shallow-water species closely approaching *M. miles*, A. M.-E. The carapace is, however, proportionately broader, the transverse striæ are not so strongly marked, and the spines on the lateral borders are more prominent. Only the second abdominal segment is furnished with spines.

Length of body (of a ♀ with ova) 28 millim., length of chelipedes 29 millim.

Loc. Off St. Paul's Rocks, 10–60 fathoms.

Munida Haswelli, n. sp.

Rostrum twice the length of the ocular peduncles, the supraocular spines slightly exceeding the latter. Carapace with the striæ numerous, tuberculate, and the hairs densely set; gastric region with two spines situated behind the supraoculars, and several spinules on the hepatic and branchial areas. Chelipedes slender, the digits long and in contact

throughout. The second abdominal segment with from four to eight spines.

Length of body (of an adult ♂) 31 millim., the chelipedes wanting in this the largest specimen.

Loc. Station 163 [off the New South Wales coast], 120 fathoms.

Munida gracilis, n. sp.

A small species resembling the northern *M. tenuimana*, G. O. Sars. The spiny armature of the carapace is similar to that of the latter, with the exception that there are no spines on the posterior border. The rostrum is very long and slender, more than twice the length of the supraocular spines, and these latter exceed the ocular peduncles. The chelipedes are of greater length and tenuity than in *M. tenuimana*, the propodi and digiti being unusually long. The second and third abdominal segments are alone furnished with spines, and these are more numerous on the second.

Length of body (of a ♀) 24 millim.; length of chelipedes 36 millim.

Loc. Station 166 [off New Zealand], 275 fathoms.

Munida curvirostris, n. sp.

Rostrum more than twice the length of the supraocular spines, considerably upturned; the supraocular spines as long as the ocular peduncles, also upturned, but less so than the rostrum. Eyes very large, with the corneæ dilated. Carapace short and broad, the striæ not numerous; gastric region with a row of spines in front, the spines on the lateral borders very prominent. Chelipedes robust, with several large spines. Tarsi of ambulatory limbs long. The second abdominal segment with a row of spines.

Length of body (of a ♀) 27 millim.; length of chelipedes 21 millim.

Loc. Station 210 [off the Philippines], 375 fathoms.

Munida spinifrons, n. sp.

Rostrum slender, about three times the length of the ocular peduncles, the anterior half slightly upturned, and furnished with a series of well-marked spines on either side; the supraocular spines not equalling the ocular peduncles. Carapace sparingly clothed with iridescent hairs, gastric area with a few spines in front, a single small spine on each branchial area. Chelipedes and ambulatory limbs long and slender. The second abdominal segment with two small spines.

Length of body (of ♀ with ova) 19 millim.; length of chelipedes 22 millim.

Loc. Station 113 A [Fernando Noronha], 7-25 fathoms.

Munida tuberculata, n. sp.

Rostrum about twice the length of the ocular peduncles, carinated dorsally, and with a slight tendency to serration near the apex; the supraocular spines short and flattened. Carapace with the striæ well marked and tuberculate, the gastric region with a row of small compound tubercles in front. Chelipedes and ambulatory limbs furnished with tubercles, which show a tendency to become spinulose. The second abdominal segment armed with a few spines.

Length of body (of a ♂) 10 millim.; length of chelipedes 12 millim.

Loc. Station 172 [south of the Fiji Is.], 240 fathoms; Station 173, near the last, 315 fathoms.

Munida spinicordata, n. sp.

Rostrum slightly exceeding the ocular peduncles, the supraocular spines nearly as long as the rostrum, separated by a wide interval. Eyes large and flattened. Carapace with two small spines on the gastric region and a prominent mesial one on the cardiac region, those on the lateral borders very minute, except the first, which is well marked. Chelipedes very slender, with a row of spines on the inner border. Ambulatory limbs long and slender. The second, third, and fourth abdominal segments with spines.

Length of body (of a ♂) 14 millim.; length of chelipedes 20 millim.

Loc. Station 174 [off the Fiji Is.], 210 fathoms.

EUMUNIDA, S. I. Smith.

Eumunida, Proc. U. S. Nat. Mus. 1883, vol. vi. no. 1, p. 44.

Eumunida Smithii, n. sp.

A small species allied to *E. picta*, Smith. The rostrum and first pair of supraocular spines deflexed. Lateral borders of carapace armed with five or six small spines; gastric region with three minute spinules situated between the second supraocular and the first marginal spine; of these the first is smallest, whereas in *E. picta* it is large and prominent. Chelipedes wanting in the only specimen.

Length of body 15 millim.

Loc. Station 192 [off the Ki Is.], 129 fathoms.

Munidopsis, Whiteaves.

Munidopsis, Amer. Journ. Sci. 3rd series, vol. vii. p. 212 (1874).
Galathodes, A. Milne-Edwards, Bull. Mus. Comp. Zool. Harv. Coll. vol. viii. no. 1, p. 53 (1880).

Munidopsis brevimana, n. sp.

Rostrum spinulous, slightly upturned towards the tip. Carapace glabrous, with small transverse raised lines; gastric region swollen, armed with two prominent spines, the lateral borders with four or five spines. Eye-stalks movable, prolonged into a delicate spine both above and below the colourless corneæ. Chelipedes shorter than the first pair of ambulatory limbs, the digits broad and excavated. Ambulatory limbs having the meral and carpal joints with a row of spines superiorly, the propodi nearly twice the length of the tarsi. The second, third, and fourth abdominal segments with a slight transverse bicarination.

It is allied to *M.* (*Galathodes*) *Renoldsi*, A. M.-E.

Length of body (of a ♀ with ova) 60 millim.; length of chelipedes 32 millim.

Loc. Station 218 [off the Admiralty Is.], 1070 fathoms.

Munidopsis subsquamosa, n. sp.

Rostrum spinulous and nearly straight, slightly compressed laterally. Carapace sparingly pubescent, covered posteriorly with raised imbricated lines (giving a scale-like appearance); in front showing a tendency to become tubercular or spinose; gastric region circumscribed, armed with several spines, the hepatic and anterior branchial regions deeply excavated. Lateral borders of carapace with two prominent upturned spines in front, and several smaller behind these. Eye-stalks slightly movable, prolonged into a spine in front of the cornea. Chelipedes robust, the various joints tuberculate, the merus and carpus slightly spiny. Ambulatory limbs robust, the first pair slightly exceeding the chelipedes, with the meral, carpal, and propodal joints sparingly tuberculate and spiny. Abdominal segments tuberculate, the second, third, and fourth slightly bicarinate transversely.

Length of body (of a ♂) 67 millim.; length of chelipedes 46 millim.

Loc. Station 237 [off the Japanese coast], 1875 fathoms.

Munidopsis Milleri, n. sp.

Rostrum short and spinulous, slightly upturned. Carapace

with a few raised transverse lines posteriorly, almost smooth in front; gastric region circumscribed, armed with two small spines (occasionally four); the cardiac region circumscribed and with several spinules on the anterior border. Lateral borders of carapace four-spined, the posterior border raised, and armed with from five to eight spines. Chelipedes with the propodal joints flattened and a single large blunt tooth on each digit. Ambulatory limbs long and slender. The second and third abdominal segments transversely bicarinate, the fourth slightly carinate.

Length of body (of a ♀ with ova) 33 millim.; length of chelipedes 39 millim.

Loc. Station 207 [off the Philippines], 700 fathoms.

Munidopsis trifida, n. sp.

Rostrum armed with two lateral teeth, the central point long and upturned. Carapace glabrous, with slight transverse rugosities; two prominent spines on the gastric region and four on the lateral borders. The eye-stalks not prolonged into spines. Chelipedes slender, with three rows of spines on the meral joints and a single row on the inner surface of the propodi. Ambulatory limbs long, the meral and carpal joints with a row of spines on the upper border. Abdominal segments smooth, the second and third slightly grooved transversely.

It is allied to *M.* (*Galathodes*) *latifrons*, A. M.-E., and *M.* (*Galathodes*) *tridens*, A. M.-E.

Length of body (of a ♀) 40 millim.; length of chelipedes 47 millim.

Loc. Station 310 [Straits of Magellan], 400 fathoms.

Munidopsis pilosa, n. sp.

Rostrum long and spinulous. The body and limbs covered everywhere with short densely-set hairs. Eyes rudimentary, the corneæ very minute, each ocular peduncle prolonged into a long spine which runs parallel with but does not equal the rostrum. Chelipedes very short, not twice the length of the external maxillipedes. Ambulatory limbs robust, the meral joints strongly spined above and below.

Length of body (of a ♂) 24 millim.; length of chelipedes 10 millim.

Loc. Station 196 [off Gilolo Is.], 825 fathoms.

Elasmonotus, A. Milne-Edwards.

Elasmonotus, A. Milne-Edwards, *l. c.* p. 60.

Elasmonotus latifrons, n. sp.

Rostrum broadly triangular, simple and flattened. Carapace covered everywhere with rounded tubercles, the regions well marked. Eyes minute, the corneæ rudimentary, ocular peduncles fused with the side of the rostrum. Chelipedes robust, granulated. Ambulatory limbs short and robust, granulated; upper borders of meral, carpal, and propodal joints with a row of blunt spines. Second, third, and fourth abdominal segments transversely bicarinate.

Length of body (of a ♂) 34 millim.; length of chelipedes 23 millim.

Loc. Station 218 [off the Admiralty Islands], 1070 fathoms.

Elasmonotus marginatus, n. sp.

Allied to the last; the rostrum, however, is narrower and turned up and the tubercles on the carapace larger. The lateral borders of the carapace are characteristically raised and project upwards and outwards. The chelipedes and ambulatory limbs are clothed with hairs and spines both on the upper and lower margins, the spines being most prominent on the carpal and meral joints. The second, third, and fourth abdominal segments are strongly carinate transversely.

Length of body (of a ♀ with ova) 50 millim.; length of chelipedes 32 millim.

Loc. Station 168 [off New Zealand], 1100 fathoms.

Elasmonotus Miersii, n. sp.

Rostrum short, with the sides parallel at first, then abruptly tapering to the apex. Surface of body and limbs everywhere minutely granulated. Gastric region of carapace well mapped out, with two prominent blunt spines in front. Chelipedes with several rounded tubercles on the inner border of the meral joints. Ambulatory limbs with a row of tubercles on both the upper and lower borders of the meral joints. Abdominal carinæ almost obsolete.

Length of body (of a ♂) 15 millim.; length of chelipedes 17 millim.

Loc. Station 173 [off the Fiji Islands], 300 fathoms.

Elasmonotus asper, n. sp.

In this species the carapace is remarkably flattened and covered everywhere with rough tubercles, the intervals between

these being finely granulated. The rostrum is flattened and spiniform, with the apex bidentate, the upper point turned up and blunt, the lower broad and flattened. Chelipedes and ambulatory limbs tuberculate, the tarsi short and curved, without teeth on the lower border. Second and third abdominal segments tuberculate, and each with a prominent dorsal projection.

Length of body (of a ♀ with ova) 28 millim.; length of chelipedes 27 millim.

Loc. ~~Station 107 [off the coast of Brazil]~~, 1500 fathoms; station 311 [Straits of Magellan], 245 fathoms.

Galathopsis, n. subgen.

The characters of this proposed new subgenus are somewhat intermediate between those of *Munidopsis* and *Elasmonotus.* The rostrum is triangular, flattened, and simple, resembling that of *Diptychus.* The carapace is swollen and without spines or ridges, the orbito-antennal border short and nearly horizontal. The eye-stalks are freely movable and without spines, the corneæ being pigmentless. The limbs are short and robust. It is distinguished from *Munidopsis* by the form of the rostrum and by the absence of spines on the surface of the carapace; while it differs from *Elasmonotus* chiefly in the form of the carapace, which in the latter genus is usually depressed.

Galathopsis lævigata, n. sp.

Rostrum long and acute. Carapace glabrous, sparingly clothed with fine hairs; the orbito-antennal border with a prominent spine behind the eye, also two on the lateral border near its junction with the former. Chelipedes robust, clothed with delicate hairs and almost obsolete polished tubercles; the digits spoon-shaped. Ambulatory limbs robust and hairy, with polished scales; the meral joints prolonged into a spine at the upper and outer border, the tarsi strongly toothed. Internal antennæ very short, the basal joint stout and spiny. Merus of the external maxillipedes short and broad, with two well-marked spines on the inner border. Abdominal segments smooth, the second, third, and fourth faintly carinate.

Length of body (of a ♀ with ova) 33 millim.; length of chelipedes 18 millim.

Loc. Station 219 [off the Admiralty Islands], 150 fathoms.

Galathopsis debilis, n. sp.

Allied to the last, but the carapace is minutely punctate

and the orbito-antennal and lateral borders are without spines; the rostrum also is shorter. The chelipedes and ambulatory limbs are hairy and minutely granulated. The abdominal carinæ are more strongly marked than in *G. lævigata*.

Length of body (of a ♂) 18 millim.; length of chelipedes 11 millim.

Loc. Station 173 [off the Fiji Islands], 300 fathoms; station 210 [off the Philippines], 375 fathoms.

GALACANTHA, A. Milne-Edwards.

Galacantha, A. Milne-Edwards, *l. c.* p. 52.

Galacantha bellis, n. sp.

Allied to *G. rostrata*, A. M.-E.*; the granulations of that species are, however, superseded by small spiniform tubercles; the central gastric spine is broader and flatter, the lateral spines are narrower and separated by a wider interval, while the spines on the under surface of the base of the rostrum are smaller, and the latter is more elevated.

Length of body (of a ♀ with ova) 65 millim.; length of chelipedes 38 millim.

Loc. Station 300 [off Juan Fernandez], 1375 fathoms.

PTYCHOGASTER, A. Milne-Edwards.

Ptychogaster, A. Milne-Edwards, *l. c.* p. 63.

Ptychogaster Milne-Edwardsi, n. sp. †

Rostrum more than twice the length of the ocular peduncles, spiniform and upturned. Carapace covered with spines arranged in longitudinal rows. Chelipedes and ambulatory limbs very long and slender, covered with rows of spines; the digits of the chelæ smooth and their apposed edges furnished with short hairs and a few minute teeth. All the abdominal segments thickly beset with small spines.

Length of body (of a ♂) 55 millim.; length of chelipedes 118 millim.

Loc. Station 310 [Straits of Magellan], 400 fathoms.

Ptychogaster lævis, n. sp.

Rostrum slightly exceeding the ocular peduncles, almost straight. Carapace glabrous, unarmed, with the exception of a few small spines on the gastric region, the lateral borders

* S. I. Smith, Bull. Mus. Comp. Zool. vol. x. no. 1, pl. ix.

† Narrative of the Voyage of the 'Challenger,' vol. i. pt. 2, p. 900, fig. 330.

with about five delicate spines. Chelipedes very slender, furnished with rows of spinules, the ambulatory limbs with spatulate tarsi. Abdominal segments smooth and glabrous.

Length of body (of a ♀ with ova) 15 millim.; length of chelipedes 32 millim.

Loc. Station 192 [off the Kai Islands], 129 fathoms.

Diptychus, A. Milne-Edwards.

Diptychus, A. Milne-Edwards, *l. c.* p. 61.

Diptychus insignis, n. sp.

Rostrum long, slightly upturned, with two or three minute lateral teeth towards the apex. Eyes minute. Carapace with a row of small spines in front, extending across the gastric and hepatic regions, the remainder of its surface smooth and glabrous: the lateral border furnished nearly as far as its posterior termination with small spines, of which the first and those corresponding to the ends of the gastro-hepatic row are largest. Chelipedes robust, the meral and carpal joints strongly tuberculate and armed with several prominent spines. Ambulatory limbs with the tarsi short and strongly toothed, the inferior margin of the propodal joints produced distally and furnished with spines.

Length of body (of a ♂) 32 millim.; length of chelipedes 44 millim.

Loc. Station 145 [off Prince Edward Island], 310 fathoms.

Diptychus spinimarginatus, n. sp.

Rostrum almost straight, long and narrow, the borders with two or three minute teeth towards the apex. Eyes minute. Carapace narrowed anteriorly, sparingly clothed with delicate hairs, especially towards the sides, the posterior half of the lateral borders armed with five large spines and a few smaller in front of these. Chelipedes long, slender, and cylindrical, the carpal and propodal joints smooth and about equal in length. Ambulatory limbs with the upper border of the meral joints spiny, the first pair very slender.

It is allied to *D. armatus*, A. M.-E., but in the latter the carapace is armed laterally with seven or eight spines, and the ambulatory limbs are smooth.

Length of body (of a ♀ with ova) 21 millim.; length of chelipedes 29 millim.

Loc. Station 170 [off the Kermadec Islands], 520 fathoms; station 214 [off the Philippines], 500 fathoms.

Diptychus parvulus, n. sp.

Rostrum about three times the length of the ocular peduncles, entire, the upper surface slightly hollowed out. Carapace smooth and glabrous, the lateral borders minutely dentate. Chelipedes with the meral and carpal joints short and armed with small teeth, the hand longer and more dilated than either of the former joints. Ambulatory limbs with the meral joints slightly dentate, the propodi furnished distally with a series of spines on the lower border.

Length of body (of a ♂) 12 millim.; length of chelipedes 17 millim.

Loc. Station 310 [Straits of Magellan], 400 fathoms.

Diptychus politus, n. sp.

Rostrum narrow, only slightly exceeding the ocular peduncles; apex subobtuse. Carapace narrow and glabrous, without spines or hairs. Chelipedes smooth, the propodal joint slightly broader and longer than the carpal, the digits with two rounded tubercles on the inner border, both fingers clothed at their extremities with delicate hairs. Ambulatory limbs slender, the tarsal and propodal joints with a few spines, otherwise smooth.

Length of body (of a ♂) 15 millim.; length of chelipedes 24 millim.

Loc. Station 171 [north of the Kermadec Islands], 600 fathoms.

Diptychus australis, n. sp.

Allied to the last, but differs in the following respects:—The gastric region of the carapace is swollen and bears two very minute denticles. The chelipedes are proportionately longer and more slender, especially the carpal joints; the inner surface of the meral and ischial joints with several rows of very minute tubercles. The propodi of the ambulatory limbs long. The squama of the external antennæ equals the peduncle in length, whereas in *D. politus* it is very small.

Length of body (of an adult ♀) 21 millim.; length of chelipedes 39 millim.

Loc. Station 164 [off Port Jackson], 410 fathoms; station 170 [north of the Kermadec Islands], 520 fathoms; station 171 [north of the Kermadec Islands], 600 fathoms; station 194 [off Banda Island], 360 fathoms.

Diptychus gracilimanus, n. sp.

Allied to *D. politus* and *D. australis*, but differs from both

in the greatly elongated and slender chelipedes; the eyes also are smaller than in either of these species. The carapace, chelipedes, and ambulatory limbs are everywhere smooth and glabrous.

Length of body (of a ♀ with ova) 20 millim.; length of chelipedes 50 millim.

Loc. Station 164 [off Port Jackson], 410 fathoms.

Diptychus tridentatus, n. sp.

Rostrum hollowed out superiorly, the apex tridentate. Lateral borders of the carapace armed with small spines; a few minute denticles on the subhepatic region. The terminal joint of the peduncle of the external antenna prolonged into a spine. Chelipedes and ambulatory limbs wanting in the only specimen.

Length of body (of a ♀ with ova) 12 millim.

Loc. Probably from the East-Indian archipelago. It is labelled "Amboyna, 15 fms.," but, judging from the known vertical distribution of the genus, this is evidently a mistake.

XL.—*Notes on Australian Lepidoptera, with Descriptions of new Species.* By Rudolph Rosenstock, B.A.

[Plate XI.]

[Concluded from p. 385.]

Notodontidæ.

Nadiasa, Walk.

(169.) *Nadiasa parvigutta*, Walk.

Nadiasa parvigutta, Walk. *l. c.* v. p. 1015.

Discophlebia, Feld.

(195.) *Discophlebia catocalina*, Feld.

Discophlebia catocalina, Feld. Novara Het. pl. xcvi. fig. 8.

(419.) *Discophlebia Lucasii* ♀, n. sp. (Pl. XI. fig. 4.)

Head cinereous grey, with a transverse black line in front of the antennæ; thorax greyish, anterior third tawny brown, bordered by chocolate-brown in front and by a brownish-

black lunular patch behind; a black stripe laterally, covered by the tegulæ, and bordered by greyish white behind, crosses dorsal surface of thorax behind middle; abdomen darkish grey.

Upperside.—Fore wings purplish grey, with a brownish-black, basal, ⊢-shaped mark, an irregular dull, faint, greyish-black band, traversed by a well-defined black, inwardly whitish-bordered, prominently angulated line; a second dark reddish-brown undulated line from costa at a short distance from inner line to about middle of hind margin; orbicular and reniform spots grey whitish, bordered by dark reddish brown.

Hind wings dark cinereous grey, with long mouse-grey hairs upon base and along abdominal margin.

Underside.—Fore wings darkish grey, lighter in discal region; basal two thirds of costal margin bluish grey, crossed in middle by an obliquely outwardly-directed, short blackish dash, forming the dilated upper termination of a subbasal line, the greater part of which is hidden by greyish hairs covering the inner discal area of the wing.

Hind wings pale whitish grey, irrorated with bluish grey, hind margin and apical part of costa broadly bordered by dull smoky black; a transverse, smoky black, posteriorly attenuated and abbreviated stripe from costa just before middle; thorax and basal part of abdomen densely woolly; fringes short, greyish, darker at base.

Expanse of wings 43 millim.; length of body 15 millim.

Psychidæ.

THYRIDOPTERYX, Steph.

(337.) *Thyridopteryx Herrichii*, Westw.

Oiketicus Herrichii, Westw. Proc. Zool. Soc. 1854, p. 232, pl. xxxvii. fig. 3.

CLANIA, Walk.

Clania, Walk. *l. c.* iv. p. 963.

(369.) *Clania tenuis*, n. sp. (Pl. XI. fig. 3.)

Allied to *Clania Lewinii* (Westw. P. Z. S. 1854, p. 231, pl. xxxvii. fig. 1), but much smaller and more hyaline. Antennæ black, head and thorax densely woolly, with intermingled grey and blackish hairs; wings hyaline, covered with minute, very fine auricular scales; veins brownish. Expanse 10 millim.

Cymatophoridæ.

URABA, Walk.

(266.) *Uraba lugens* ♀, Walk.

Uraba lugens ♀, Walk. *l. c.* xxviii. p. 449 (Phycidæ).
Cæsa viduella ♂, Walk. *l. c.* Suppl. v. p. 1729 (Tortrices).
Toxoloma australe ♀, Feld. Novara Het. pl. C. fig. 16.

I certainly think the Cymatophoridæ the right place for this species. Mr. Meyrick considers it a Pyralid; on what grounds I utterly fail to see.

NOCTUITES.

Hadenidæ.

EUPLEXIA, Steph.

(835.) *Euplexia confundens*, Walk.

Euplexia confundens, Walk. *l. c.* ii. p. 544.

Leucaniidæ.

LAPHYGMA, Guén.

(593.) *Laphygma cycloides*, Walk.

Laphygma cycloides, Walk. *l. c.* ix. p. 190.

Apparently a species of wide range. All the other specimens in the British Museum, which exhibit no perceptible difference from that from Australia, are from the Cape.

HADENA, Schrank.

(533.) *Hadena bistrigula*, Walk.

Hadena bistrigula, Walk. Cat. Lep. Het. xi. p. 599.

Homopteridæ.

HOMOPTERA, Boisd.

Homoptera, sp.

Too much mutilated and worn for description, but very closely allied to *Homoptera* (*Thermesia*, Walk.) *impropria* ♀, Walk. Lep. Het. Suppl. iii. p. 1064. The markings exactly correspond, but *impropria* is much smaller; the male of the same species occurs again in the collection under the MS. designation of *Hadena homopteroides*, but I cannot find it under that name in the Catalogue or anywhere else.

Deltoididæ.

Rhapsa, Walk.

(324.) *Rhapsa suscitatalis*, Walk.

Hypæna suscitatalis, Walk. *l. c.* xvi. p. 83.

Walker did not know the locality of his type.

Bertula, Walk.

(540.) *Bertula thyrisalis*, Walk.

Bertula thyrisalis, Walk. *l. c.* xvi. p. 167.

Bleptina, Guén.

(403.) *Bleptina?* * *sordescens*, n. sp. (Pl. XI. fig. 11.)

Dull smoky grey. Fore wings with a faintly indicated transverse median band, having somewhat darker zigzag inner and outer margins which are irregularly bordered by clearer greyish white, and containing an obscure ill-defined pale greyish-white reniform spot, surrounding a linear semilunar greyish dash; hind margin bordered by a pale greyish-white border, slightly iridescent in some positions, and presenting on its inner margin three dentate projections, one apical, a second more evenly triangular just above middle of hind margin, and a second bicuspid one near the anal angle.

Hind wings dull smoky greyish, with faint indications of a median transverse stripe and a pale marginal band as in fore wings, but with quite straight inner border.

Underside.—Paler, grey whitish, with brownish-grey discocellular spots, small, faint, and indefinite on fore wings, much larger, deeper, tinted and subovate on hind wings; a brownish-grey transverse stripe, narrow and faint on front wings, broader and more distinct on hind wings; a broad dull smoky-grey submarginal band-like effusion, and the pale greyish-white hind marginal band, with its inner border dentated in fore wings; even in hind wings, as on upperside; fringes rather shorter, greyish white; palpi long, recurved over head and front of thorax; the first joint somewhat roughly scaled

* The generic position of this species must be taken as provisional. *Bleptina* appears to me to contain a number of species referable to separate genera, but which I could not spare time to examine critically. Venation will be found to be of little help, being, as far as I could see, tolerably uniform throughout the group, and, in fact, throughout the whole of the Deltoids. The palpi, wing-form, &c. may afford better aid towards a rearrangement of the species.

beneath, pale fuscous, with a distinctly raised small darkish-grey patch of scales just below the point of articulation of the second joint, which is narrower and smoother than the second; third joint shorter, narrower, and smoother, acute at apex, with a flattened bush of hairs emitted from its inner surface near the base. Antennæ ciliated, one cilium on each side of each joint being longer and stronger than the rest, greyish fuscous; thorax dark purplish grey, with scattered grey-whitish scales; collar and side tegulæ well developed; anal valves covered by a tuft of silky whitish hairs; abdomen and legs pale brownish, hind tibiæ with two pairs of spurs, the upper pair being much the longer.

Expanse 44 millim.; length of body 19 millim.

The specimen seems somewhat worn, but is, I think, sufficiently well characterized to be identifiable from the description.

LITHILARIA, n. g.

Allied (in shape of wings and specific pattern) to *Gisira*, Walk. (Cat. xvi. p. 71), a South American genus, also represented in Japan.

Palpi very long, ascending and curved backwards over head; first joint distinctly visible, broad, flattened, and roughly scaled; second joint long, broad, and flattened, roughly scaled underneath; third joint as long as second, also flattened, but narrower and much smoother, with a loose bunch of long stiff hairs rising from its base behind; antennæ ciliated, proboscis long and robust. Head and thorax rather roughly scaled; abdomen moderately long, slender, with well-developed anal valves.

Fore wings moderately broad, outer margin slightly falcate from apex to centre, then straight and oblique to anal angle.

Hind wings somewhat broader, outer margin rounded, slightly undulated.

Venation.—Fore wing: vein 2 from anterior third of cell, 3, 4, 5 from one point at posterior angle of cell; with vein 6 from lower vein 7, the long stalks of veins 8, 9, and vein 10 from the upper angle of a short narrow triangular præcostal areolet, vein 11 from about half of cell.

Hind wing: vein 2 from a little to the basal side of the middle of cell, 3, 4, and 5 from same point at posterior angle, 6 and 7 from same point at upper angle, 8 (costal) touching subcostal only near base.

(448.) *Lithilaria ossicolor*, n. sp.

Pale ochreous whitish (bone-colour); the markings, owing

to wear, are very obscure and indefinite, scarcely allowing of adequate description. They consist of irregular transverse lines, formed by aggregated darkish-brown scales. There appears to be on the fore wing a subbasal line from one fourth of costa to hind margin; a second broader angulated line from about middle of costa to one third of hind margin, where it closely approaches the subbasal line; an indistinct, much blurred discocellular mark, and an irregular submarginal zigzag line, broadest near its costal end; this and the second line are continued faintly across hind wing, and here, midway between them, is another equally faint greyish fuscous line. There is on both wings a hind marginal series of blackish-brown interneural dots.

Under surface.—In fore wings strongly irrorated with blackish grey, and with a brownish costal blotch a little before apex corresponding to the broad costal end of the submarginal band on the upperside.

Hind wings much more sparsely irrorated with blackish grey; median and submarginal lines more distinct, and interior subbasal line fainter, except in the middle of the cell, where it forms a distinct discocellular litura. Expanse 29 millim.

Pyrales.

Epipaschiadæ.

Catamola, Meyr.

Catamola, Meyr. Tr. Ent. Soc. 1884, p. 63.

(509.) *Catamola funerea,* Walk.

Acrobasis funerea, Walk. *l. c.* xxvii. p. 31.

A single large female.

Astrapometis, Meyr.

Astrapometis, Meyr. *l. c.* p. 67.

(570.) *Astrapometis saburalis,* Walk.

Pyralis saburalis, Walk. *l. c.* xix. p. 914.

Pyralididæ.

Messatis, Walk.

(154.) *Messatis pyrosalis,* Guén.

Endotricha pyrosalis, Guén. Delt. et Pyr. p. 219.
Paconia albifimbrialis, Walk. *l. c.* Suppl. iv. p. 125.

Tricomia auroralis, Walk. *l. c.* p. 1259.
Rhodaria robina, Butler, Ann. & Mag. Nat. Hist. (5) ix. p. 96.

I propose to retain Walker's first name for the genus of this much-baptized species, for while recognizing its very close affinity to *Endotricha*, Zell., I cannot follow Mr. Meyrick in referring it to the latter genus.

Eurycreon, Led.

(148.) *Eurycreon familiaris*, Meyr.

Eurycreon familiaris, Meyr. Trans. Ent. Soc. 1884, p. 336.

I have retained Mr. Meyrick's name, though I am nearly convinced that he has merely redescribed Walker's *Scopula segestalis* (*segestusalis*, Walk.), which he must have overlooked. The type of the latter species is, however, so bad that it should never have been described.

There is also a fragmentary and unidentifiable specimen of a species of *Paraponyx*, St. (47), and a species (170) of *Sedenia*, Guén., in a similar condition.

Isopteryx, Guén.

(219.) *Isopteryx nitidalis* ?, Walk.

Isopteryx nitidalis ?, Walk. *l. c.* Suppl. iv. p. 1318.

A much worn specimen. Of Walker's type only a body and hind wing remain; but there is another more recent specimen from New Zealand in the collection. I can find no reference to this species in Mr. Meyrick's papers.

Scoparia, Haw.

(485.) *Scoparia* (*Scopula*) *cleodoralis*, Walk.

Scoparia (*Scopula*) *cleodoralis*, Walk. *l. c.* xviii. p. 793.

(99.) *Scoparia exhibitalis*, Walk.

Scoparia exhibitalis, Walker, *l. c.* Suppl. iv. p. 1500.

(748.) *Scoparia pusilla*, n. sp.

Fore wings dark smoky grey, irrorated with deeper black, with an outwardly oblique, narrow, transverse, pale greyish-white band from basal fourth of costa to about basal third of inner margin; a second irregular, angulated, pale band from costa at two thirds, and an irregular, abbreviated, angulated, ill-defined stripe upon hind margin; fringes smoky grey at base, tips whitish. Hind wings smoky grey, lighter towards base; fringes as in fore wings.

Underside dull leaden greyish, with faint indications of the markings. Maxillary and labial palpi blackish, whitish at tips; antennæ minutely blackish and white-ringed. Head, thorax, and abdomen dull blackish grey. Expanse 11 millim.

In pattern it has some resemblance to *S. hawaiensis*, Butler, Hawaian Islands (Ann. & Mag. Nat. Hist. (5) vii. p. 330), but much smaller, in fact the smallest *Scoparia* I have seen.

Geometrites.

Urapteridæ.

Idiodes, Guén.

(434.) *Idiodes siculoides*, Walk.

Choara siculoides, Walk. *l. c.* xxi. p. 291.

Ennomidæ.

Odontopera, Steph.

(433.) *Odontopera australis* ♂, n. sp. (Pl. XI. fig. 9.)

Shining sericeous grey. Fore wings with a slight ochreous tinge; a few scattered blackish atoms, and faint grey, somewhat linear irrorations along costal and outer margins; a faint zigzag subbasal line, a deep black linear discocellular spot, and a blackish, sharply dentated, submarginal line. Hind wings paler cinereous grey, without ochreous tinge or markings, except very faint indications of a discocellular spot and of a denticulate submarginal line.

Under surface of both wings concolorous, shining grey, with greyish-brown irrorations, the front wings being somewhat darker and having a pale ochreous-grey speckled costal border; faintly-indicated discocellular spots and a common dentate submarginal line, somewhat punctiform on the hind wings. Head, palpi, antennæ, thorax, and abdomen pale ochreous grey.

Expanse 30 millim.; length of body 8 millim.

Has a good deal of resemblance to *Odontopera fragilis*, Butl., from Chili (Tr. Ent. Soc. 1882, p. 356).

Œnochromidæ.

Arhodia, Guén.

(688.) *Arhodia retractaria*, Walk.

Arhodia retractaria, Walk. *l. c.* xxi. p. 282.

Boarmidæ.

BOARMIA, Treitsch.

(679.) *Boarmia cognata*, Walk.

Boarmia cognata, Walk. *l. c.* xxi. p. 392.

TEPHROSIA, Boisd.

(834.) *Tephrosia fractaria*, Guén.

Tephrosia fractaria, Guén. Phal. i. p. 270.

Geometridæ.

CHLOROCHROMA, Guén.

(657.) *Chlorochroma cadmaria*, Guén.

Chlorochroma cadmaria, Guén. *l. c.* p. 315.

IODIS, Hüb.

(637.) *Iodis meandraria*, Guén.

Iodis meandraria, Guén. *l. c.* p. 355.

THALASSODES, Guén.

(102.) *Thalassodes*, sp.

Specimen too much worn for description.

Acidalidæ.

IDÆA, Treits.

(422.) *Idæa perlata*, Walk.

Acidalia perlata, Walk. *l. c.* xxiii. p. 776.

(308.) *Idæa oppilata*, Walk.

Acidalia oppilata, Walk. *l. c.* p. 776.

(408.) *Idæa albicostata*, Walk.

Acidalia albicostata, Walk. *l. c.* p. 779.

(495.) *Idæa repletaria*?, Walk.

Acidalia repletaria?, Walk. *l. c.* Suppl. v. p. 1624.

(246 and 308.) Worn specimens, unidentifiable and unfit for description.

(402.) *Idæa farinalis* ♀, n. sp.

Pale sandy greyish white; face pale ochreous brown; palpi short, not extending beyond head; terminal joint short, blackish at tip.

Wings dusty grey ochreous whitish, with minute and faint brownish discocellular spots, and very obscure, hardly distinguishable, darker median and submarginal transverse lines, the former passing outside of discocellular spot on fore wings, inside of it on hind wings; fringes concolorous with wings.

Underside paler and smoother; no trace of transverse markings, but discocellular spots distinct, especially on hind wings. Expanse 26 millim.

Ligiidæ.

CHLENIAS, Guén.

(596.) *Chlenias seminigra* ♂, n. sp.

Head, palpi, antennæ, and thorax black; abdomen fuscous-grey above, blackish below; legs darkish grey.

Fore wings coal-black on upper, cinereous grey on under surface; outer margin obtusely angulated near middle.

Hind wings grey on upper and under sides, with an indistinct, blackish, linear, discocellular spot, only visible on under surface; fringes black in fore, greyish in hind wings. Expanse 42 millim.

(258.) *Chlenias indecesata*, Walk.

Chlenias indecesata, Walk. Lep. Het. xxiv. p. 1153.

Caberidæ.

STEGANIA.

(644.) *Stegania? allongata*, Feld.

Stegania? allongata, Feld. Novara Het., pl. cxxxi. fig. 15.

Not a *Stegania*; its proper family position would appear to me to be among the Macariidæ.

Fidoniidæ.

FIDONIA, Treits.

Fidonia perornata, Walk.

Lythria perornata, Walk. Cat. Lep. Het. xxiv. p. 1056.

PANAGRA, Guén.

(302.) *Panagra inostentata*, Walk.

Panagra inostentata, Walk. *l. c.* xxiii. p. 1012.

(672.) *Panagra intermixtaria*, Walk.

Panagra intermixtaria, Walk. *l. c.* xxiii. p. 1000.

(687.) *Panagra intercalata*, Walk.

Panagra intercalata, Walk. *l. c.* xxiii. p. 1012.

DASYURIS, Guén.

(311.) *Dasyuris metaxanthata*, Walk.

Cidaria metaxanthata, Walk. *l. c.* xxvi. p. 1734.

(478.) *Dasyuris decisaria*, Walk.

Fidonia decisaria, Walk. *l. c.* xxiv. p. 1038.

Larentiidæ.

PHRYSSOGONUS, Butl.

Phryssogonus, Butl. Ann. & Mag. Nat. Hist. (5), ix. p. 94.

(268.) *Phryssogonus laticostatus*, Walk.

Larentia laticostata, Walk. *l. c.* xxiv. p. 1196.
Scotosia canata, Walk. *l. c.* xxv. p. 1357 (Butler's type of *Phryssogonus*).

LARENTIA, Treitsch.

(66.) *Larentia solutata*, Walk.

Coremia solutata, Walk. *l. c.* xxv. p. 1319.

CHRYSOLARENTIA, Butl.

(629.) *Chrysolarentia vicissata*, Zell. MS.

Coremia vicissata, Guén. Phal. ii. p. 421, pl. 9. fig. 5.

(109.) *Chrysolarentia lucidulata* ♂, Walk.

Cidaria lucidulata, Walker, *l. c.* xxv. p. 1407.

This species presents all the characters of Butler's new genus, to which I have accordingly referred it.

CASBIA, Walk.

(617.) *Casbia melanops* ♂, n. sp. (Pl. XI. fig. 10.)

Pale greyish brown, with a slight roseate tinge (*café au lait*), minutely speckled with dull greyish, especially along costal margin of fore wings, and with the following markings common to both wings; a faint, dull brick-red, transverse, somewhat undulated median stripe passing on the fore wings just outside, on the hind wings inside of a black, orbicular, discocellular spot, which is encircled by a faint fine ring of whitish

scales, largest on the fore wings; a second outer, sharply dentate, reddish line from $\frac{3}{4}$ length of costa of fore wing to $\frac{3}{4}$ inner margin of hind wings, followed by a submarginal series of interneural, outwardly deep blackish, inwardly brownish-red punctiform spots, and a hind-marginal series of black dots upon the ends of the veins. On the fore wings there is an additional straight, very obscure, reddish, subbasal stripe; fringes concolorous with wings.

Underside pale sericeous whitish grey, speckled with black along costal borders, with discocellular spots as above, but fainter, and with faint indications, especially on the hind wings, of the submarginal row of spots.

Head reddish brown. Thorax and abdomen concolorous with wings.

Expanse 27 millim., length of body 7 millim.

(678.) Another much worn specimen of the same species with the colour nearly all worn off and markings almost totally obliterated.

Euboliidæ.

Eubolia, Dup.

(286.) *Eubolia undulata*, n. sp.

Head, antennæ, and palpi grey, irrorated with brownish; thorax sparingly covered with light bluish-white scales. Legs greyish fuscous.

Fore wings pearly bluish grey, with a series of well-defined, parallel, narrow, undulated, brownish-grey lines, a short, black, discocellular spot, and an abbreviated, obliquely inwardly directed, blackish, apical dash; a hind marginal series of narrow blackish dashes, interrupted by clayish brown ill-defined spots placed upon the ends of the veins.

Hind wings pale grey, whitish towards base, darker greyish along hind margin, with the dark transverse lines very faint, distinct only on the abdominal margin, and the clay-brownish hind marginal spots fainter and much less definite than in the fore wings; fringes grey-whitish, darker greyish at base.

Underside dark grey, brownish along outer margin, paler towards base, with undulating lines and cellular spots obscurely marked.

Expanse 25 millim.

Coremia, Gn.

(663 *a.*) *Coremia permissata*, Walk.

Coremia permissata, Walk. *l. c.* xxv. p. 1317.

(663.) *Coremia regulata*, Walk.

Coremia regulata, Walk. *l. c.* xxv. p. 1318.

(307.) *Coremia revulsaria*, Walk.

Panagra revulsaria, Walk. *l. c.* xxvi. p. 1665.

(105.) *Coremia languescens*, n. sp. (Pl. XI. fig. 8.)

Greyish testaceous brown, with pale greyish-white and dark blackish-grey undulated and denticulated transverse lines; median area forming a deeper, more reddish-brownish band, angulated on the outside and traversed by blackish undulated lines, bordered inside and outside by a very narrow undulated pale whitish line; a narrow, pale whitish, denticulated, submarginal line, rendered obscure by a subapical irregular cloudy blackish suffusion; between it and the hind margin is a series of cupreous, reddish-brown, suboval spots, divided by short black dashes running inward from the black lunular hind marginal spots; fringes blackish grey at base, tinged with rosy at apex.

Hind wings ochreous yellow, with abbreviated brownish and blackish stripes upon abdominal margins, and with a hind marginal line of blackish connected lunular dashes, as in fore wings; fringes as in fore wings, but quite pale yellowish round apex.

Underside pale ochreous, with brownish marginal borders, followed by a dark fuscous apical suffusion in fore wings, in hind wings by a broad, irregular, dark fuscous band; base in both wings powdered with greyish fuscous, median area with discocellular spots and traversed by several fuscous undulated lines.

Head, thorax, and abdomen greyish testaceous brownish.

Expanse 28 millim.

Allied to *C. mecynata* (*Camptogramma mecynata*, Guén. Phal. ii. p. 424), but differs in the deeper brownish tint of fore wings and the absence of a complete blackish hind marginal border on the upper surface of the fore wings. It must also bear a very close resemblance to *Camptogramma bichromata* (Gn. *l. c.* p. 425), but does not in all respects correspond to the description of that species.

CIDARIA, Treitsch.

(833.) *Cidaria responsata*.

Cidaria responsata, Walk. *l. c.* xxv. p. 1409.

PHIBALAPTERYX, St.

(85.) *Phibalapteryx disrupta*, Walk.

Boarmia disrupta, Walk. *l. c.* xx. p. 391.

(88.) *Phibalapteryx phibalapteraria*, Guén.

Tephrosia phibalapteraria, Guén. *l. c.* i. p. 268.

(490.) *Phibalapteryx attributa*, Walk.

Boarmia attributa, Walk. *l. c.* xxi. p. 390.

A female. A male of this species from Tasmania was described by Walker as *Hemerophila vestita* (*l. c.* xxi. p. 322).

ACODIA, n. g.

A genus allied to *Coremia* in general body-structure and form, but differing by the dentate hind margin of the hind wings, and more especially by the venation of the fore wings. Unlike any of the allied genera of the Larentiidæ (Guén.), *Cidaria*, *Camptogramma*, &c., there is no præcostal cell (aréole); veins 6 and 7 are emitted from nearly the same point at the upper angle of the cell and run separately to the hind margin; veins 8, 9, 10, 11 are all branches of a common stalk, emitted from the subcostal cell $\frac{2}{5}$ of its length before the upper angle; 8 and 9 forming the forked terminal branches and rising from a common point; 10 and 11 given off separately from the stem. The venation of the hind wing is normal; veins 6 and 7 rise from a short common stalk, 8 (costal) is united to the cell till just before its anterior angle.

(30.) *Acodia pauper*, n. sp. (Pl. XI. fig. 7.)

In pattern this species closely resembles *Larentia? rufescens*, Butler, New Zealand (Cist. Ent. ii. p. 502).

Fore wings pale whity brown, traversed by numerous parallel undulated brownish lines, with minute blackish discocellular spots, and with irregular blackish-grey suffusions upon the costa and within the submarginal border. Hind wings more whitish towards costa and base, with discocellular spots and transverse outwardly abbreviated brownish-grey undulated lines, broadest upon lower part of abdominal margin; terminal border in both wings formed by a series of blackish-brown lunular dashes. Fringes darkish grey, with a narrow, pale whity brown basal line.

Underside pale sandy white; fore wings with costal border tinged with pale ochreous; a very faintly indicated common transverse greyish undulated line from $\frac{3}{4}$ costa of fore wings to

middle of abdominal border of hind wings, which have a second greyish, also ill-defined, submarginal band. Head pale brownish, irrorated with greyish. Thorax with an anterior transverse blackish stripe and three posterior black spots. Abdomen pale whitish ochreous, with two distinct black dots on each segment, and other smaller greyish irrorations.

Expanse 26 millim., length of body 10 millim.

The specimen appears to me somewhat rubbed, and consequently this description may not exactly represent the appearance of a perfectly fresh insect.

Crambidæ.

Diptychophoridæ.

Diptychophora, Zell.

(815.) *Diptychophora ochracealis*, Walk.

Cataclysta ochracealis, Walk. *l. c.* Suppl. iv. p. 1338.
Diptychophora præmaturella, Meyr. Trans. Linn. Soc. N. S. Wales, vol. iii. p. 198.

A very poor example.

Two specimens in the Zeller collection, labelled as Mr. Meyrick's species, are absolutely identical with Walker's type.

Thisanotia, Hüb.

(227.) *Thisanotia aurantiaca*, Meyr.

Thisanotia aurantiaca, Meyr. Proc. Linn. Soc. N. S. Wales, vol. iii. p. 175, and vol. vii. p. 153.

Sorocostia, n. g.

Antennæ of male moderately ciliated; labial palpi fairly long (about twice the length of the head), porrected, roughly scaled, third joint quite concealed.

Fore wings with 11 veins, 8 and 9 from a stalk rising out of 7, from about its middle, all into costa, 7 just above apex; 9 is very short and faint, and without denudation and careful examination likely to be overlooked.

Hind wings with 7 veins—3 from angle of cell, 4 widely separated from near middle of cell, 5 and 6 from a stalk, 7 from cell just before middle.

I am obliged to create a new genus of Crambidæ for the reception of *Eromene? vetustella*, Walker, wrongly placed in the collection under *Diptychophora*, and apprently quite overlooked by Meyrick. In neuration it differs from any of the

genera described by the latter. Its nearest ally seems to be *Ptochostola*, Meyr. (Trans. Linn. Soc. N. S. W. vol. vii. p. 154).

(489.) *Sorocostia vetustella*, Walk.

Eromene? vetustella, Walk. *l. c.* Suppl. 5, p. 1763.

Head, thorax, and palpi snowy white, sparingly speckled with fuscous grey.

Fore wings fuscous grey, with a snowy white, longitudinal, angulated, costal stripe from base to costa, at three fifths, containing three well-marked blackish spots, one near base, the second (the largest) at the middle in the angle of the band, the third smaller at its posterior termination; the apex suffused with white, which is continued as a narrow, oblique, white, transverse line to two thirds of inner margin; it is clouded internally by some irregular darkish suffused markings; a faint dark fuscous zigzag subbasal line is continued from below the second subcostal spot to about one fourth of inner margin.

Hind wings greyish.

I have redescribed this species, as Walker's type was much worn, and the description consequently quite inadequate.

ANCYLOLOMIA, Hübn.

(843.) *Ancylolomia ruptella*, Walk.

Crambus ruptellus, Walk. *l. c.* xxvii. p. 173.
Pnonophora ruptella, Meyr. Trans. Linn. Soc. N. S. W. vol. iii. p. 179, vol. iv. p. 240.

This species does not belong to the Crambidæ, and its true position is doubtful.

TORTRICITES.

Tortricidæ.

ACROPOLITIS, Meyr.

(84.) *Acropolitis signigerana*, Walk.

Tortrix signigerana, Walk. *l. c.* xxviii. p. 332.
Sciaphila rudisana, Walk. *l. c.* xxviii. p. 349.
Penthina indecretana, Walk. *l. c.* xxviii. p. 377.
Acropolitis signigerana, Meyr. Proc. Linn. Soc. N. S. W. vi. p. 438.

TORTRIX, Linn.

(147.) *Tortrix leucaniana*, Walk.

Conchylis leucaniana, Walk. *l. c.* xxviii. p. 370.
Gelechia intactella, Walk. *l. c.* xxix. p. 652.
Teras pauculana, Walk. *l. c.* Suppl. v. p. 1781.
Tortrix leucaniana, Meyr. Proc. Linn. Soc. N. S. W. vi. p. 517.

Absolutely identical with the New Zealand specimens in

the British-Museum collection; forms an exception to Mr. Meyrick's statement that no two species are common to the two countries (*l. c.* vi. p. 415).

Conchylidæ.

BONDIA, Newm.

(849.) *Bondia nigella*, Newm.

Bondia nigella, Newm. Trans. Ent. Soc. Lond. vol. iii. n. s. p. 289; also Meyrick, Trans. Linn. Soc. N. S. W. vol. vii. pp. 180-182.

Meyrick's account of the neuration of the hind wings is not quite correct, veins 3 and 4 being emitted from the same point at the posterior angle of the cell, and not remote from each other.

TINEITES.

Tineidæ.

TINEA, L.

(792). *Tinea comptella*, Walk.

Tinea comptella, Walk. *l. c.* xxx. p. 1007.

This is certainly not a *Tinea*, the smooth head, smooth, flattened, subquadrate face, the narrow, linear, naked, and widely divergent palpi, combined with the very narrow lanceolate hind wings, lead me to consider it as allied to *Butalis*.

(842.) *Tinea? fraudulens*, n. sp. (Pl. XI. fig. 12.)

Head loosely haired, deep yellow; palpi dark fuscous; second joint with a few separate stiff hairs; terminal joint minutely conical. Antennæ nearly if not quite as long as front wings, dark fuscous. Thorax dark metallic blackish violaceous. Abdomen dark ochreous. Legs dark fuscous.

Fore wings elongate, lanceolate, bright yellow, with a dark blackish fuscous, oblique, transverse, irregularly bordered fascia irrorated with dark blue metallic scales from $\frac{3}{4}$ costa to about middle of inner margin, continued round anal and apical angles as an attenuated hind marginal border, the whole forming a D-shaped mark. Fringes greyish fuscous; underside of fore wings and both sides of the rather narrow lanceolate hind wings dark golden brownish, with purplish metallic iridescence; fringes of hind wings dark greyish fuscous, about $\frac{1}{2}$ breadth of wing.

Expanse 14 millim.

I am doubtful as to the true generic position of this species. The antennæ seem to me too long for a *Tinea*, though it

agrees with that genus in neuration and characters of palpi. In pattern and markings, on the other hand, it approaches the Adelidæ, and is especially like *Edosa hemichrysella*, Walk., Java (*l. c.* Suppl. v. p. 1819), type in B. M.

Adelidæ.

ADELA, Latr.

(223.) *Adela chrysolamprella*, n. sp.

Top of head rather loosely covered with short pale ochreous hairs; face, basal joints of antennæ, under surface of thorax and of legs sprinkled with golden metallic iridescent scales.

Fore wings purplish violaceous, iridescent, with golden metallic irrorations, a straight, margined, darkish blue median band irrorated with coarse blackish, and a few grey-whitish scales; fringes greyish black, sprinkled with metallic-golden scales.

Hind wings grey towards base, marginally purplish violaceous iridescent; fringes greyish black. Expanse $5\frac{1}{2}$ millim.

The tints of this insect vary with the different position in which it is held. I am describing it as looked at vertically from above.

Glyphipterigidæ (Meyr.).

HYPERTROPHA, Meyr.

Hypertropha, Meyr. Trans. Linn. Soc. N. S. W. vi. p. 208.

(701.) *Hypertropha divitiosa*, Walk.

Anthæcia divitiosa, Walk. *l. c.* Suppl. iii. p. 771.

Appears to have been overlooked by Meyrick. Quite distinct from *desumptana*, Walk. (*Orosana d.*, *l. c.* xxiii. p. 460, redescribed as *thesaurella*, Meyr. P. L. S. N. S. W. v. p. 209), being smaller, the cupreous black marginal border of the hind wing narrower, and the yellow longitudinal discal band on the under surface of the fore wing of *desumptata* being absent.

Gelechiidæ (Meyr.).

GELECHIA, Zell.

(807.) *Gelechia clerica*, n. sp.

Head and thorax glossy white; head smoothly haired; palpi, second joint dilated with scales in front, blackish below and at base, white above and at apex; third joint longer than second, linear, erected, white; apex blackish. Abdomen whitish fuscous above, grey blackish beneath. Legs greyish

black. Fore wings narrow, elongated, parallel, margined with a broad, sharply-defined, deep black, longitudinal, discal band from base to apex; costa and hind margin bordered along their whole length by a glossy whitish, longitudinal fascia. Hind wings pale light greyish, semitransparent. Under surface of front wings dull leaden grey; of hind wings as above.

Expanse 15 millim.

Has all the characters of a true *Gelechia.*

Cryptolechiidæ (Meyr.).

Agriophara, n. g.

This genus presents a remarkable exception in the venation of the fore wings, veins 7 and 8 being emitted separately from the angle of the cell and not from a common stalk, as is the typical arrangement in all the families into which Mr. Meyrick has subdivided the Gelechiidæ. The other characters of the genus, and more especially the forking from a common stalk of veins 6 and 7 of the hind wings, lead me to refer it to the Cryptolechiidæ.

Head with appressed scales on face, more loosely scaled behind and at sides. Antennæ stout, strongly ciliated in the male; basal joint stout, without a pecten; palpi moderate, bent upward; second joint thickened somewhat roughly below; third joint slightly shorter than second, quite smooth, erect, pointed. Thorax smooth; posterior tibiæ with long hairs and four long spines; abdomen rather flattened. Fore wings elongate, ovate; apex rounded, hind margin obliquely rounded, cilia short. Hind wings decidedly broader than fore wings, emarginate below apex.

Venation.—Fore wing: vein 2 from just before angle of cell, strongly arched outwards, 3 and 4 from a common moderately long stalk, emitted at posterior angle of cell; 5 approximated to the stalk of 3 and 4; 7 and 8 entirely separated throughout, 7 to apex.

(239.) *Agriophara cinerosa,* n. sp.

Head, palpi, antennæ, thorax, and fore wings ashy grey; hind wings and upperside of abdomen dull leaden grey; under surface of abdomen and legs whitish grey.

Fore wings with a short, longitudinal, outwardly attenuated and abbreviated stripe from extreme base of costa, and bordered below by whitish scales. Veins, especially the lower median of the cell and its branches (2, 3, 4), striped irregularly with dark fuscous.

Underside of both wings glossy lead-grey; front wings somewhat darker.

Species resembles *Chimabacche cinderella*, Newm. Tr. E. S. L. new ser. vol. iii. p. 288, pl. xviii. fig. 6 (a species which must also be referred to this genus, differing utterly from Chimabacchidæ in neuration), but is darker, shorter, and narrower in the wings, with the dark marking on fore wings forming distinct stripes instead of spots.

Agriophara diminuta ♂, n. sp.

Head, palpi, thorax, legs, and abdomen ashy grey. Fore wing cinerous irrorated with whitish, and with a series of small linear dark fuscous spots along the margins of wings, especially distinct on outer margins, and with dark fuscous irrorations scattered over discal region of wing; fringes whitish grey, irrorated with blackish.

Hind wings leaden grey, darker along outer margin and around apex.

Under surface of front wings dark leaden grey; of hind wings glossy whitish grey.

Expanse 17 millim.

In form and markings similar to *cinderella* and *cinerosa*, but very much smaller.

CONŒCA, Scott.

Conœca, Scott, Austral. Lepid. pt. iii. p. 26.

(423.) *Conœca irrorea* ♀, Feld.

Conœca irrorea, Feld. Novara Het. pl. cxxxviii. fig. 40.

A damaged and worn specimen; its generic characters agree perfectly with those of *Conœca*, and I have little doubt as to its being the female of Felder's species, the figure of which appears to me a poor one.

The affinities of this genus are doubtful. I have left it among the Tineidæ, where Felder placed his species. Scott, followed by Walker, placed it among the Psychidæ, with which it has nothing in common, except that the pupa builds a case. Perhaps it is safest to consider it provisionally as an aberrant Tineid.

Œcophoridæ (Meyr.).

PALPARIA, Wing.

(848.) *Palparia euryphanella*?, Meyr.

Palparia euryphanella?, Meyr. Proc. Linn. Soc. N. S. W. vii. p. 435.

I believe this to be Mr. Meyrick's species, though the

single and somewhat worn specimen does not altogether agree with his description; but I hesitate to make it a type on a few small discrepancies which may possibly be due to abrasion.

Heliocausta (Meyr.).

(12.) *Heliocausta limbata*, Meyr.

Heliocausta limbata, Meyr. *l. c.* vii. p. 471.

(488.) *Heliocausta tryphœnatella*, Walk.

Cryptolechia tryphœnatella, Walk. *l. c.* xxix. p. 753.
Cryptolechia œcophorella, Walk. *l. c.* xxix. p. 760; Meyrick, *l. c.* vii. p. 477.

Eulechria, Meyr.

Eulechria, Meyr. *l. c.* vii. p. 508.

(840.) *Eulechria leucopsina*, n. sp. (Pl. XI. fig. 5.)

Head white; palpi rather long; second joint passing beyond base of antennæ, white on inner, dark greyish fuscous on outer surface; third joint dark fuscous; thorax white, with small antero-lateral blackish spots; antennæ greyish fuscous; abdomen wanting, but very probably ochreous as in *E. epicausta*, to which this species is very closely related. Anterior legs blackish grey; middle legs yellowish, irrorated with greyish; posterior legs glossy pale ochreous opaline whitish, irrorated with greyish; tibiæ with long yellow hairs above; tarsal joints greyish ochreous on inner, darkish grey on outer surface. Fore wings moderately elongated, apex round, hind margin oblique, anal angle rounded, pure somewhat iridescent white, with an ochreous, almost chestnut-brown transverse fascia, from 2 of costa to $\frac{1}{3}$ of inner margin, slightly dilated near middle; a second broader, similarly coloured band enclosing a nearly circular clear white spot from $\frac{2}{3}$ costa to hind margin, just before anal angle, and an ochreous chestnut, subtriangular, hind-marginal blotch, which nearly touches the outer margin of the second band near the middle; fringes pale ochreous whitish, dull slaty grey at apex. Hind wings glossy grey, with a slight purplish tinge; tips pale ochreous irrorated with greyish, and whole of fringe along abdominal margins much paler, whitish; slaty greyish at apex of wing. Expanse 19 millim.

This species is easily distinguished from its nearest allies by the white spots in the second band and by the basal area being pure white.

In the Godeffroy collection of Microlepidoptera I saw a specimen noted by Mr. Butler—on Mr. Meyrick's opinion, I

understood—as near the genus *Epicausta*, resembling it in all but the before-noted white spot in the second band.

The following species, all belonging to the Œcophoridæ*, I am obliged at present to leave under their old genera, as that portion of Mr. Meyrick's paper in which they are treated has not come to hand. With single specimens it is useless trying to make out their genera from the diagnostic table, especially as some are characterized from one sex only.

(441.) *Œcophora? isabella*, Newm.

Œcophora? isabella, Newm. Trans. Ent. Soc. Lond. iii. (n. s.) p. 295, pl. xviii. fig. 2.

(131.) *Œcophora? subnexella*, Walk.

Œcophora? subnexella, Walk. Cat. Lep. Het. xxix. p. 691.

(61.) *Cryptolechia? placidella*, Walk.

Cryptolechia? placidella, Walk. *l. c.* xxix. p. 751.

(850.) *Œcophora? apertella*, Walk.

Œcophora? apertella, Walk. *l. c.* xxix. p. 698.

All the other specimens in the collection are from New Zealand, but they cannot be distinguished from the Australian form.

EOCHROA, Meyr.

(469.) *Eochroa protophaes*, Meyr.

Eochroa protophaes, Meyr. Proc. Linn. Soc. N. S. W. vii. p. 457.

One specimen, agreeing very well with Mr. Meyrick's description.

PHILOBOTA, Meyr.

(841.) *Philobota fascialis*, Fab.

Phalæna fascialis, Fabr. Syst. Ent. p. 644, n. 128.
Tortrix bimaculana, Don. Ins. New Holl. pl. 40. fig. **.
Œcophora bimaculella, Newm. Trans. Ent. Soc. Lond. iii. (n. s.) p. 293.
Œcophora bimaculana, Walk. *l. c.* xxix. p. 657; Felder, Novara Het. pl. cxxxviii. fig. 48.
Philobota bimaculana, Meyr. Proc. Linn. Soc. N. S. W. viii. p. 507.

The Fabrician type of this species is in the Banksian collection.

(25.) *Philobota interlineatella*, Walk.

Œcophora interlineatella, Walk. *l. c.* xxix. p. 692; Meyrick, *l. c.* viii. p. 501.

(737.) *Philobota pretiosella*, Walk.

Psecadia pretiosella, Walk. *l. c.* xxviii. p. 538; Meyr. *l. c.* viii. p. 499.

* At p. 377, line 5 from top, *for* Acophoridæ *read* Œcophoridæ.

Philobota declivis, Walk.

Œcophora declivisella, Walk. *l. c.* xxix. p. 687.

(838.) *Philobota athletica*, n. sp. (Pl. XI. fig. 13.)

Near *Œcophora xanthiella*, Walk. (*l. c.* xxix. p. 693), one of the smaller and, according to Mr. Meyrick, most ancestral species of this large genus, which approaches *Eulechria* and *Peltophora*.

Head deep yellow; palpi whitish yellow above, dark fuscous beneath; antennæ, anterior and middle legs dark fuscous; posterior legs pale ochreous pearly white; thorax reddish purplish fuscous; abdomen dark fuscous; posterior segmental margins and anal tuft pale ochreous pearly white.

Fore wings elongate, rather narrow; costa moderately arched; apex rather pointed, hind margin strongly oblique, anal angle moderately rounded; deep yellow, with a reddish purple, longitudinal, subcostal, discal, linear dash, widening and forking out anteriorly into two branches; the upper continued along costa to apex, and thence along hind margin round anal angle, where it unites with the obliquely downward and forwardly directed lower branch, the whole forming a suborbicular ring with basally directed angle, giving it somewhat the appearance of a tennis-bat. Fringes pale ochreous whitish, darker near anal angle.

Hind wings grey; fringes pale ochreous pearly whitish, with a greyish basal line, yellowish towards apex.

Under surface of both wings shining grey; front wings somewhat darker, with a brownish tint. Expanse 17 millim.

Pterophoridæ.

PLATYPTILUS, Zell.

(751.) *Platyptilus emissalis*, Walk.

Platyptilus emissalis, Walk. *l. c.* xxx. p. 930.

PTEROPHORUS, Geoffr.

(179.) *Pterophorus canalis*, Walk.

Pterophorus canalis, Walk. *l. c.* xxx. p. 944.

(16.) *Pterophorus* —— ?

A quite unrecognizable specimen.

XLI.—*Note on* Ceratium hirundinella (*O. F. Müller*), *its Variability and Mode of Reproduction.* By Dr. Henri Blanc*.

[Plate XII. figs. 4–9.]

In the 'Compte Rendu' of the meeting of the Société de physique et d'Histoire naturelle de Genève, on the 17th April, 1884, p. 545, Prof. Brun cites among the pelagic vegetation collected in the spring in Lake Leman, near Geneva, a Cilio-flagellate, *Ceratium hirundinella*, Bergh, synonymous with *Ceratium macroceras*, Schr. Without adding further details, the author of the communication says that this Peridinian, which is furnished with a strong siliceous envelope, has occurred pretty abundantly several times.

Nearly at the same time Dr. Imhof published (Zeitschr. für wiss. Zool. Bd. xl. Heft i.) the results of his researches upon the pelagic fauna of the Swiss Lakes, and, among other new species, described a new Cilio-flagellate which he baptized with the name of *Ceratium reticulatum*.

Knowing the uniformity which exists in the faunas of our different Swiss lakes, a uniformity which may be so frequently recognized in the numerous investigations made by Prof. Forel, I tried to discover in the pelagic fauna of the Lake of Geneva the species of *Ceratium* indicated by Prof. Brun and the new species described by Dr. Imhof.

In the produce of my very first fishing, performed on a fine day towards the end of May, I found in abundance, at a depth of 10 metres, *Ceratium hirundinella*, O. F. Müller†, and *Ceratium reticulatum*, Imhof, in company with another Cilio-flagellate, which, I think, has not yet been mentioned as living in our Swiss lakes, namely *Glenodinium cinctum*, M.

More than this, a considerable amount of material enabled me to ascertain that *Ceratium hirundinella*, like the other species of *Ceratium* so carefully studied by M. Bergh‡, presented a great variability of form, and that, in reality, Dr. Imhof's new species was not distinct, but rather formed part of the cycle of this variability.

Before discussing the question of identity between *Ceratium reticulatum* and *C. hirundinella*, I will give some details as to the organization of this Cilio-flagellate of the Swiss

* Translated from the 'Bulletin de la Société Vaudoise des Sciences Naturelles,' sér. 2, vol. xx. pp. 305–315, pl. x. (February 1885).

† To avoid confusion, I always adopt, as the author's name, that of the naturalist who first described the animal referred to.

‡ Bergh, "Der Organismus der Cilioflagellaten. Eine phylogenetische Studie," Morphol. Jahrb. Bd. vii. Heft 2 (1881).

lakes, and communicate some new and exact observations upon the mode of reproduction of this group of microscopic creatures, which has hitherto been very problematical.

The body of the *Ceratium* of the Lake of Geneva, seen in front, is flattened, seen from the side nearly biconvex. It is surrounded and limited by a skeletogenous membrane or cuirass, which is produced in the shape of horns differing in dimensions and directions.

One of these horns (fig. 4, *a*), the largest, is denominated the anterior horn, the animal always moving in the direction of this extremity; the three others (fig. 4, *b*), or sometimes only two, of unequal length, are the posterior horns. This kind of external skeleton is not continuous throughout, and is not everywhere of the same thickness. About the middle of the body it becomes excessively delicate and forms a perfectly well-marked cincture (fig. 4, *c*); and the skeleton is also completely interrupted upon one of the surfaces of the body. This interruption is formed by a large groove with parallel margins, nearly perpendicular to the cincture (fig. 4, *d*); it opens near the base of what I will for the moment call the great posterior horn, and terminates in a rounded end at the level of the cincture or a little below it. The width of this groove, measured in several specimens, varies from 0·014 to 0·015 millim., its length is 0·030 millim. It is the surface of the body which presents this groove that I call the ventral surface, the other, which has nothing of the kind, being the dorsal surface.

The skeletogenous membrane is not of a siliceous nature, as Prof. Brun says, but is formed, as M. Bergh perceived, of cellulose or of a very similar carbon hydrate; for in *Ceratia* treated with iodized chloride of zinc, the skeletogenous membrane always became slightly tinged with violet. This cuirass is very transparent, presents no pores, and possesses a very elegant structure. Under a low power it appears to be very regularly divided into a quantity of little polygonal dark areas, separated from each other by small white bands; under a high power we seem to see that these polygonal areas are so many little fillets (*Leisten*) which, towards the extremity of the horns, become elongated, and by their superposition cause the contours of the latter to appear as if slightly denticulated.

The skeletogenous membrane encloses a protoplasmic mass which contains a nucleus. The protoplasm, which penetrates to the extremity of the horns, is differentiated into a very thin external part, the *exoplasm* (fig. 5, *ex*), and a larger internal part, the *endoplasm* (fig. 5, *en*).

Treated with osmic acid, chromic acid, or picro-sulphuric acid, the *Ceratia* of the Lake of Geneva show an exoplasm which is not homogeneous, as described by M. Bergh in *Ceratium* and *Peridinium*; it is rather vacuolar in the species under consideration (fig. 5, *ex*). The endoplasm (fig. 5, *en*), which is denser, contains very fine granules, large and small globules of a green or yellow colour, or even red, and, lastly, other colourless, but very refractive, globules. Of the green and yellow globules the former are the more numerous; this abundance of green globules always gives the living *Ceratia* a well-marked greenish coloration, which is produced by chlorophyll. The quantity of yellow globules varies much in different specimens; M. Bergh ascribes this coloration to the presence of diatomine. The red globules are much more rare than the preceding, and frequently their presence cannot be recognized; when they exist there are only one or two of them. These red globules are very large, always placed near the ventral orifice (figs. 5 and 6, *gl. r.*). After the application of the reagents mentioned above they contract, generally leaving around them a well-defined vacant space; each globule then appears as if contained in a vacuole. M. Bergh, who observed these red globules in *Ceratium cornutum,* regards them, I believe rightly, as being of an oily nature, and ascribes to them a part in the act of assimilation. As to the refractive colourless globules which are observed in all specimens (fig. 5, *gl. g.*), they are of a fatty nature, for they are immediately coloured brown by osmic acid.

The nucleus of the *Ceratia* of the Lake of Geneva is of an oval form (figs. 5, 6, *n*); it occupies nearly the middle of the body, and its longer axis is most frequently parallel to the cincture. It is 0·030 millim. long by 0·010 millim. broad; it possesses a spherical nucleolus placed excentrically, 0·003 millim. in diameter (fig. 5, *nu*). The intimate structure of the nucleus and nucleolus varies according to the histological reagents employed. In specimens fixed by chromic acid and stained with picrocarmine, the nucleus appears to be finely granulated, and the nucleolus like a small homogeneous refractive body, absorbing more of the colouring substance than the rest of the nucleus (fig. 5). In other specimens fixed by picro-sulphuric acid and coloured with acetic carmine, the chromatic substance of the nucleus appears in the form of small bacilli held in suspension in the nuclear liquid without forming a network of any kind (fig. 5 *bis*); the nucleolus, instead of being a well-coloured refractive body, has precisely the aspect of a vacuole or of a rounded colourless body (fig. 5 *bis, nu*). The nuclear membrane, which is excessively thin, is always visible.

M. Bergh * gives no details as to the protoplasm and the nucleus of *Ceratium hirundinella*, and contents himself with saying: "As regards the protoplasm, cell-nucleus, &c., this form appears exactly to resemble *Ceratium cornutum*." According to this author therefore the nucleus of *Ceratium hirundinella* is elongated with its longer axis parallel to the longer axis of the animal, and does not contain any nucleolus. If these facts were well established I admit that it would require a great exertion of the imagination to confound under a single species the *Ceratium* found in the Swiss lakes and the *Ceratium hirundinella* of O. F. Müller. But the same author takes care to add further on, in speaking of the latter form:—"Of this form (in opposition to that above described) I have observed only a few individuals, and therefore I am unable to state anything as to its variability; nevertheless the material was sufficient for me to determine the homologies and the systematic position of this freshwater form." It appears clearly from this phrase that M. Bergh, having a deficiency of material, has chiefly attended to the external form of the animal, neglecting to study its protoplasm and nucleus; this author, therefore, must not take it ill if I regard what he says upon this subject as only a simple supposition.

Although I have had under my eye several dozens of *Ceratia* I have never been able to discover a contractile vesicle—an observation which, moreover, is in accordance with those made by M. Bergh and others.

In describing the skeletogenous membrane I have stated that it is interrupted on one of the surfaces of the body, the ventral surface, and that it bounded a large groove; from the bottom of this groove, when we observe living animals, there issues a flagellum (fig. 6, *f*), sometimes as long as the body, which strikes the water, keeping generally a posterior position, while the animal always moves in the direction of the anterior horn. If the existence of this long flagellum is not difficult to establish, it is otherwise with the circlet of vibratile cilia, which, according to the authors who have paid attention to the Cilio-flagellate Infusoria, is placed below one of the margins of the cincture. I have never been able to observe any such circlet of cilia in living specimens, or in others treated with reagents. Nor have I been able to recognize the presence of the two flagella which, according to the recent observations of Dr. G. Klebs †, replace, in the *Ceratium*

* Bergh, *loc. cit.* p. 216.

† G. Klebs, "Ueber die Organisation einiger Flagellaten-Gruppen und ihre Beziehungen zu Algen und Infusorien," in Untersuchungen aus d. botan. Inst. zu Tübingen, Bd. i. Heft 2 (Leipzig, 1883).

cornutum investigated by him, the circlet of cilia described by his predecessors.

The *Ceratium* here treated of dies very rapidly; out of hundreds captured in the morning I have very often had difficulty in finding a few specimens in the evening; most of them were motionless at the bottom of the vessel; when examined under the microscope all had the contractile part of the body issuing through the ventral aperture.

Reproduction.

As yet we are in possession of very few *positive facts* with regard to the mode of reproduction of the cuirassed Cilio-flagellata, and especially of *Ceratium*. Even among these few facts there are some which have been very differently interpreted, sometimes as demonstrating a reproduction by division, sometimes as being stages of conjugation. Thus Perty * thought he had observed a reproduction by longitudinal scissiparity in a species of *Ceratium*, which must be the same as ours; Stein †, on the contrary, that he saw a *Ceratium* of the Baltic reproduce by conjugation. Pouchet ‡ cites a curious observation made by him upon individuals belonging to the species *Ceratium tripos* and *furca*; he found these attached to each other, forming chains of three, four, and even eight individuals—chains which, according to Pouchet, could not originate from a conjugation. Bergh § states that he has several times observed two individuals belonging to the species *Ceratium cornutum* united to each other and having no longer more than a part of their skeleton; he is inclined to believe in conjugation rather than in division.

That such a contradiction exists in the explanation of the observed facts is because none of the authors cited has paid serious attention to the intimate transformations which may have taken place in the protoplasm and the nucleus. Thanks to the employment of histological reagents and to numerous observations made upon living specimens, I can assert that in all cases *Ceratium hirundinella propagates by division, after a previous division of its nucleus.*

I have stated above in describing the nucleus that it was of an elongate oval form, and possessed only a single nucleolus; but this is not always the case. Fig. 6 represents

* Perty, 'Zur Kenntniss kleinster Lebensformen,' &c. (Berne, 1852).

† Stein, 'Der Organismus der Infusionsthiere, III. Der Organismus der Flagellaten oder Geisselinfusorien,' i. Hälfte (Leipzig, 1878).

‡ Pouchet, "Sur l'évolution des Péridiniens" &c. in 'Comptes Rendus,' tome xcv. p. 794 (1882). See also 'Annals,' ser. 5, vol. x. p. 477.

§ Bergh, *loc. cit.* pp. 214 and 268.

a *Ceratium* first of all observed in the living state, and which I succeeded in preserving in Canada balsam, after having fixed it by means of picro-sulphuric acid and stained it with picro-carmine. The nucleus of this *Ceratium* is not of the usual form; it is less elongated, for instead of measuring 0·030 millim. in length by 0·010 millim. in breadth, it is not more than 0·023 millim. long by 0·013 millim. broad—that is to say, it has now the form of a regular oval. Moreover, instead of having a single nucleolus, this nucleus contains two of them, placed excentrically, at a distance from each other. Whence do these two nucleoli originate? Is one of them the nucleolus generally observed in every nucleus, while the other has been formed independently at the expense of the chromatic substance? or are they both the products of the division of a single nucleolus? Although I have no observations to prove it, I can nevertheless assume that these two nucleoli are the products of the division of the single nucleolus which occurs in every elongated nucleus. In fact if one of them had been formed at the expense of the chromatic substance, the latter would have undergone some modification in its mode of distribution; or among the nuclei examined, which possessed two nucleoli, I must necessarily have met with at least one possessing one nucleolus smaller than the other—that is to say, in a condition of growth. I have never been able to observe either the one or the other of these two facts; the distribution of the chromatic substance in the interior of the nucleus was always the same, and the two nucleoli always possessed the same diameter.

Fig. 7 represents a *Ceratium* of which the nucleus has undergone a notable transformation as regards its form. It is neither elongated nor oval, but is strongly constricted in the middle, and appears to be incompletely divided into two exactly similar halves, each possessing a nucleolus. The contents of the nucleus in this specimen are still the same as in that above described; we remark no peculiar arrangement of the chromatic substance.

Fig. 8 represents an interesting individual, observed and drawn in the living state, but which, to my great regret, could not be preserved in Canada balsam. What strikes one first of all in this specimen is that its nucleus does not occupy the usual position; instead of being situated almost entirely in the posterior [anterior] region of the body, below the circlet, it is placed across the latter. As in the preceding individual, the nucleus still appears as if divided into two equal parts; but the central part which unites them is much more slender. Important modifications are also to be observed in the

skeletogenous membrane. The ventral aperture is no longer the same, but is only a very narrow groove; from the base of the right posterior horn (the *Ceratium* being seen from its ventral surface) starts a groove, passing (and this is an important point to ascertain) exactly over the constricted portion of the nucleus. This groove traverses the circlet to reach the left-hand margin of the posterior [anterior] region of the body, and is continued upon the dorsal surface; it consequently divides the individual into two dissimilar parts, but each containing half of the nucleus.

If the reader has carefully followed me in the description that I have just given of the three individuals drawn in figs. 6, 7, and 8, he will have no difficulty in recognizing with me that I have had before me three important stages of the *Ceratium* under consideration, and that they enable us to conclude that its reproduction takes place by division.

Thus, to sum up, this reproduction commences by the division into two equal parts of the original single nucleolus contained in every nucleus. (According to Prof. Gruber * the division of the nuclei of *Amœba proteus* also commences by the division of the nucleoli.) The two halves of the nucleolus separate from each other and the nucleus acquires a regular oval form, although its contents do not differ from what they were before. Then the nucleus becomes constricted in the middle, and this constriction becomes more and more strongly marked until the nucleus appears to be formed of two halves united by a sort of bridge of nuclear substance. At the same time that this constriction becomes more marked the nucleus changes its position; one of its halves is situated above and the other below the cincture. At this period the skeletogenous membrane presents a furrow which divides it, and causes the *Ceratium* to appear as if incompletely divided into two. The scissiparity, therefore, is not truly longitudinal, but still less transverse.

M. Bergh † says that he has frequently had the opportunity of observing *Ceratia*, especially *Ceratium cornutum*, which were deprived of a portion of their skeleton; I have also had the pleasure of recognizing this same fact in *Ceratia* of the Lake of Geneva, and it is one of these specimens that I have drawn in fig. 9. In this individual the skeletogenous membrane covered only a part of the anterior region of the body; on all the rest of the body it had disappeared, leaving only the vestiges of a right posterior horn and of a small

* A. Gruber, "Ueber Kerntheilungsvorgänge bei einigen Protozoen," in Zeitschr. für wiss. Zool. Bd. xxxviii.

† Bergh, *loc. cit.* p. 214.

external horn. The protoplasm thus laid bare had a certain degree of consistency; and this individual moved rapidly by means of its long flagellum. The above author afterwards mentions having seen two of these individuals in which a part of the skeleton was deficient, united or stuck together by the naked part of their bodies and moving rapidly. M. Bergh cites these curious individuals without knowing what to make either of those joined two and two or of those in which a part of the cuirass is wanting. He does not know whether he is to regard the former as being in conjugation or as individuals in course of division; he rather believes in a conjugation; and as to the second sort, he says of them that they are individuals which have abandoned a part of their cuirass.

These few observations of Bergh's confirm mine in every point. This naturalist, when he speaks of individuals united or joined together, has evidently had under his eyes *Ceratia* which were in process of dividing; as to the others, of which he speaks as individuals which have abandoned their cuirass, we have only to examine carefully figs. 8 and 9 to be convinced that the *Ceratium* represented in fig. 9 is not an individual which has, so to speak, undergone an incomplete moult, but that it is the product of a division. We have only to remove the right-hand portion of the *Ceratium* in course of division (fig. 8) to have, pretty nearly, the specimen partly deprived of its cuirass (fig. 9).

In conclusion, it only remains for me to discuss the question of identity between the *Ceratium* of the Lake of Geneva, which I regard, like M. Brun, as identical with *Ceratium hirundinella*, O. F. Müller, and *Ceratium reticulatum*, the new species described by Dr. Imhof, and found by him in the lakes of Zurich, Zug, &c.

I have said in commencing that the skeletogenous membrane of the Geneva *Ceratium* is produced in the form of horns of different directions and dimensions, namely an anterior one, the largest, and three, or sometimes two, posterior ones, of smaller size. When there are three posterior horns, as in the specimen represented in figs. 6 and 7, the *Ceratium* of the Lake of Geneva has exactly the form of *Ceratium hirundinella*, O. F. Müll., described and figured by M. Bergh. When there are only two of them (fig. 5) it resembles *Ceratium reticulatum*, Imhof. But among the specimens with two and those with three posterior horns I have found others in which the horn situated outside of the left posterior horn, the

animal being seen from the dorsal surface, is no longer a horn, but only a simple stout spine (fig. 4).

Usually, when this third horn is well developed and quite evident, the other two posterior horns, which are always longer than this, diverge more from one another; while if it is only rudimentary, the two posterior horns are less divergent, and sometimes even nearly parallel. (Compare figs. 4, 6, and 7 with fig. 5.) Dr. Imhof * has found in the Katzensee *Ceratia* closely resembling his *C. reticulatum*, and only differing from it by a small eminence situated outside of the left posterior horn. This is what he says about it:—" Perhaps this species from the Katzensee might be regarded as an intermediate form between *Ceratium hirundinella*, Müller, and our first form."

It is to be regretted that M. Imhof had not abundant material at his disposal, for he would certainly have been able to convince himself that the *Ceratia* of the Katzensee were really an intermediate form. He would have seen that between the actual well-developed horn and the simple prominence there exist all the passages.

As regards dimensions the *Ceratium* of the Lake of Geneva does not differ from those of the lakes of Zurich and Zug, nor from those found by M. Bergh in the fresh water of the neighbourhood of Copenhagen. Measured upon several individuals the distance between the extremity of the anterior horn and the extremity of the left posterior horn (the individual being looked at from the dorsal surface) varied from 0·267 to 0·190 millim. All the specimens observed, whether with three or two posterior horns, had the same ventral aperture, 0·014–0·015 millim. in width, that is to say, of the same dimensions that M. Imhof gives for his specimens. I may remark further, with regard to the buccal aperture, that in fact the figure given of it by M. Bergh for *Ceratium hirundinella* is not exactly what M. Imhof and myself have observed; but I cannot attach any great importance to a simple divergence, which may originate merely from a defect in the drawing. All the *Ceratia* of the lake had also the same cuirass, the description of which given above agrees exactly with those given by MM. Bergh and Imhof of the cuirasses of the *Ceratia* which they had before them. All had the same protoplasm containing the same nucleus. Nuclei in course of division occurred in specimens with two posterior horns and in others with three horns.

This uniformity and constancy in the principal characters

* Imhof, *loc. cit.* p. 167.

authorize me in regarding the *Ceratium* of the Lake of Geneva as the *Ceratium hirundinella*, O. F. Müller, described by Bergh, and further in seeing in *Ceratium reticulatum*, Imhof, only a simple member of the cycle of variability to which this old species, like so many others, is subject.

EXPLANATION OF PLATE XII. Figs. 4–9.

(All the figures enlarged 300 diameters.)

Fig. 4. Cuirass of a *Ceratium hirundinella*, seen from its dorsal surface. *a*, anterior horn; *b*, posterior horns; *c*, cincture; *d*, ventral aperture.

Fig. 5. *Ceratium hirundinella*, seen from its dorsal surface. Only the outlines of the cuirass are drawn. *ex*, exoplasm; *en*, endoplasm; *gl. r.*, red globules; *gl. g.*, fatty globules; *n*, nucleus; *nu*, nucleolus.

Fig. 5 *bis*. Nucleus of a *Ceratium hirundinella* treated with picro-sulphuric acid and stained with acetic carmine.

Fig. 6. *Ceratium hirundinella*, drawn in the living state and then fixed, seen from the ventral surface. *f*, flagellum.

Fig. 7. *Ceratium hirundinella*, seen from the dorsal surface.

Fig. 8. *Ceratium hirundinella*, drawn in the living state, seen from the ventral surface. *s*, furrow in the cuirass.

Fig. 9. A *Ceratium hirundinella* in which a part of the cuirass is deficient, drawn in the living state and seen from the ventral surface. *pr*, naked protoplasm; *c*, cuirass.

XLII.—*Critical Observations on Prof. Leidy's "Freshwater Rhizopods of North America," and Classification of the Rhizopods in general.* By Surgeon-Major Wallich, M.D.

[Continued from p. 334.]

It has been already shown ('Annals,' Nov. 1885) that Prof. Leidy does not dispute the fact of the animal of "*Quadrula*" being in every respect identical with the animal of *Difflugia*. We must therefore not place too implicit credence in the statement made at p. 143 of his work, that "*Quadrula symmetrica* is the only representative of its genus." For Prof. Leidy has yet to explain upon what other basis than the generic *non*-identity of an organism with any other known genus, he considers it legitimate to dissociate *Difflugia symmetrica* from *Difflugia*; and, further, how he can reconcile the creation of a new genus for the reception of that form with those "investigations" which (he tells us at p. 6) "rather confirm the view that we can only regard the more conspicuous and prevailing forms as so many *nominal*

species, in likeness with the species of higher organic forms, more or less intimately related, and by intermediate forms or varieties merging into one another."

Having got rid of every question connected with the characters of the animal, it is, at all events, satisfactory to feel that the present inquiry is reduced to the, comparatively speaking, narrow issue of determining whether the characters of the test in *Quadrula* are, or are not, sufficiently unique and constant to warrant the creation of a new genus for the reception of *Difflugia symmetrica*.

As we have already been made acquainted with the characters of "*Quadrula*" *symmetrica* as laid down in Prof. Leidy's work, let us now turn our attention to the characters therein given of the genus *Difflugia*, bearing in recollection, however, that a genus is little better than an abstract conception, and that it behoves us to assure ourselves, at every step of the investigation, that the characters assigned to this particular genus as a whole, neither exceed nor fall short of the aggregate characters of the several species included in it. It will be understood as we proceed why this caution is considered necessary in dealing not only with the new genus *Quadrula*, but with the equally questionable new genus *Nebela*.

And here let me observe that, owing to the unusual length and vagueness of many of Prof. Leidy's definitions and descriptions, however desirable it may be to epitomize them to the utmost, the end in view would be defeated were any passages struck out which the author might consider essential to the due comprehension of the points at issue. When it is stated that thirty-two pages of letterpress are devoted to the genus *Difflugia* as a whole, seven to *D. pyriformis*, and the remaining twenty-five to *D. globulosa*, *D. urceolata*, *D. cratera*, *D. acuminata*, *D. lobostoma*, *D. arcula*, *D. corona*, *D. constricta*, and, lastly, *D. spiralis* (of which at least half are, on Prof. Leidy's own showing, most variable species), the difficulties in the way of condensation beyond a certain point will, I venture to think, become apparent.

The characters given of the genus *Difflugia* are:—"Shell very variable in shape, usually composed of extraneous angular particles of hyaline quartz-sand, sometimes mingled with other bodies, such as diatom-cases, sponge-spicules, &c.; the same forms sometimes composed of chitinoid membrane incorporated with scattered extraneous particles, or composed in part or entirely of intrinsic particles of peculiar character. Mouth inferior, usually terminal. . . . . . . Pseudopods usually up to half a dozen or more, cylindrical, simple or branching, commonly round at the ends, sometimes spreading and pointed."—*Op. cit.* pp. 95, 96.

The characters given of *Difflugia pyriformis* are:—"Shell *pyriform*, *flask-shaped* or *ovoid*, with the narrower pole prolonged into a neck of variable length, of uniform transverse diameters, *or more or less compressed*; fundus obtusely rounded or subacute, or more or less expanded and variably produced into from one to three conical processes; neck gradually and evenly narrowed to the oral end, cylindroid, *sometimes constricted*; mouth inferior, terminal, circular, or *slightly* oval. Structure of the shell usually of angular particles of quartz-sand, sometimes mingled with diatoms; less frequently composed of chitinoid membrane with variable proportions of diatoms and sand.

"Var. 1. *D. pyriformis*; the ordinary characteristic form with the opposite diameters uniform.

"Var. 2. *D. compressa*; like the preceding, but more or less compressed.

"Var. 3. *D. nodosa*; usually a large form like the latter, but with the fundus variably produced into from one to three eminences.

"Var. 4. *D. cornuta*; pyriform, with the fundus provided with one or two pointed conical processes.

"Var. 5. *D. vas*; like the ordinary form, but with the neck defined from the body by a constriction.

"*Difflugia pyriformis* is one of the most common *species*, and it presents much variety of shape and size. The shell is ordinarily flask-like or balloon-form, or, as indicated by the specific name, pear-shaped, with an oval or ovoid body, more or less gradually prolonged into a neck, which tapers to the mouth or is cylindroid, and of variable proportionate length. . . . . . . *Difflugia pyriformis* by gradual transition merges into *D. globulosa*, *D. acuminata*, &c."—*Op. cit.* pp. 99 to 105.

For reasons stated at great length by the author (pp. 99 to 105), but which are nevertheless far from being clear, *Difflugia proteiformis* is altogether excluded from his list of established species. At p. 113 he says:—"The name *D. proteiformis* is exceedingly indefinite in its application." And further on the characters of *D. proteiformis* are again cursorily referred to and followed by the remark that "Dr. Wallich uses the name of *D. proteiformis* in a sort of generic sense, and regards all other forms of the genus ordinarily recognized as transitional subspecies and varieties."

With reference to the last remark I can only say, in all good faith, "I own the soft impeachment," and, notwithstanding the inference it involves, I prefer still to adhere to my own definitions given below, as being more to the point,

somewhat shorter, and, at all events, less hampered by all round alternatives than those furnished in Prof. Leidy's work, which render his definitions practically useless. I therefore request attention to the subjoined extract from the synoptical list of the Difflugidæ, at p. 240 of the 'Annals' for March 1864, confining myself, however, to those forms only which bear on the question before us.

"Genus DIFFLUGIA (Leclerc).

"*Characters.* Animal a testaceous Amœban. Pseudopodia cylindrical or digitate. Test chitinoid, or chitinoid with additions of mineral matter.

"Species 1. *Difflugia proteiformis.*

"*Characters of Test.* Form of embryonic test subspherical, from 1 to $\frac{1}{8}$ of the diameter in one direction being truncated and constituting the aperture. Form of mature test extremely variable.

"Subspecies 1. *Difflugia mitriformis.*

"*Characters.* Test mitre-shaped, more or less inflated at posterior extremity, and without any fixed ratio between length and breadth.

"Var. *a.* *D. acuminata.* Apex of test acuminate.

"Var. *β.* *D. spiralis.* Anterior third of test bent back upon its body, so as to present a retort-shape.

"Var. *γ.* *D. pyriformis.* Shape varying from the pear- to the balloon-shape."—*Annals*, March 1864, p. 240.

Referring to this arrangement Prof. Leidy has drawn marked attention to my having referred the transitional (or, as I think they may be more correctly termed, the metamorphic) series, described and figured in the 'Annals' for March 1864, to *Difflugia pyriformis.* The following are my reasons for having done so.

Taking the characters of "*Quadrula symmetrica*" in the order in which Prof. Leidy records them, we find this organism described as being "remarkable for the construction of its shell, which is *compressed pyriform.*" Both of these characters are to be found in his definitions given above of *Difflugia pyriformis*, and also its variety, No. 2, *D. compressa.* But this is not all. If we turn to plate xxiv. of Prof. Leidy's work, which is devoted to "*Nebela*" and "*Quadrula,*" we shall see two tests of *Nebela*, figs. 11 and 12, which, without looking at the explanation list, we can at once recognize as constituting an inseparable bond between *Nebela* and *Quadrula* on the side of incipient mineral metamorphism, and *Nebela* and *D. pyriformis* on the side of outline. In the explanatory remarks

these are described as "transitional to the compressed variety of *D. pyriformis.*" Again, if we turn to pl. xii. of *Difflugia pyriformis*, figs. 10, 11, 12, and 13, we shall see that these might, without the least incongruity, have been inserted in pl. xxiv. as additional, and, in reality, *better* representations of the metamorphism shown in figs. 11 and 12 of that plate. A dozen such examples might be added to these were it necessary. I must, however, draw particular attention to the very important fact that these six figures also agree (as closely as any half-dozen specimens of the same forms of Difflugidæ can agree with each other) with fig. 30, plate xvi., of my series of transitional metamorphic forms of *Difflugia pyriformis*, to which I refer them, as the *first link in the chain* of varieties which lead up to *Difflugia symmetrica.* The woodcuts Nos. 3 and 4 at pp. 469, 470 of this paper are in reality specimens of *D. pyriformis*, so far as mere form is concerned; fig. 3 being the ordinary variety with the test made up of angular mineral fragments, nearly always more or less transparent. When the test is covered to this extent with large and angular mineral particles of varying sizes and shapes, it has passed the stage at which metamorphic action, or, in other words, the combinaton of the siliceous material impacted into the yielding chitinoid basis of the test, can enter into colloidal combination with it. In fig. 2 (at p. 468 of this paper) the metamorphic combination has gone as far as it generally does in such a form; attention is drawn to it now chiefly with a view to prove that the pyriform or mitriform "compressed" shape, said to be characteristic of the shell of *Quadrula symmetrica*, is one of the typical characters recorded of *Difflugia pyriformis* and its variety *D. compressa* at p. 99 of Prof. Leidy's work. Now if we look at figs. 10, 11, 12, 13 of pl. xii., representing *Difflugia pyriformis*, and figs. 4 and 12 of pl. xxiv. representing *Nebela collaris*, the truth at once bursts on us, that the figures from pl. xii. of *D. pyriformis* might be transferred to pl. xxiv., and the figs. of *Nebela collaris* from pl. xxiv. to pl. xii. of *D. pyriformis*, without even an expert in the history of the testaceous freshwater Rhizopods being able to assert positively that the whole of the six specimens were anything else than average specimens of *Difflugia pyriformis.* I contend therefore that there is nothing in the *shape* of the test in *Difflugia symmetrica* to distinguish it from the test of *D. pyriformis*, or certain metamorphic forms of *Nebela collaris* of which I shall have to speak hereafter in reference to another character.

Figs. 27 to 33 of pl. xvi. appended to my paper in the 'Annals' for March 1864, which Prof. Leidy says I "described as transitional forms of *Difflugia symmetrica*," I have

already shown have nowhere been so described by me. Those figures represented forms which were regarded by me in 1864 (and I have certainly not yet seen any reason for not so regarding them) as fairly typical varieties around which every heretofore known published variety of the metamorphic series might with propriety be grouped. These seven types, with *Difflugia symmetrica*, seem to me to cover the whole of Prof. Leidy's *Nebelæ*, excepting the horned varieties, but only as varieties. To make species, even in the widest sense, on such a basis can, I think, hardly be considered in keeping with the spirit of modern classification as applied to the Protozoa.

The next characters given of *Quadrula* are:—"Shell transparent, colourless, composed of thin* square plates of chitinoid membrane arranged in transverse or more or less oblique series, in consecutive or alternating order. . . . The general arrangement is like that of *tiling with variable regularity*. . . . They [the plates] are not entirely disposed with the symmetry expressed by their name, for frequently smaller plates break the regular succession of larger ones, and sometimes one angle of a plate replaces that of a contiguous one."—*Op. cit.* pp. 142, 143.

I have already ventured to express the opinion that Prof. Leidy's views as regards the test of *Difflugia symmetrica* (or, as he would prefer to call it, "*Quadrula*" *symmetrica*) being "composed of thin square plates of chitinoid membrane" is erroneous, so far at least as I can speak concerning my own specimens, which, I may add, have been procured over a tolerably wide geographical area. Of course Prof. Leidy's specimens may be quite correctly described, inasmuch as the degree of consolidation attained by every test of the kind in which there is an admixture of siliceous or any other soluble mineral substance with the chitinoid basis, must depend on the quantity of that substance present in the water or mud of the particular locality in which it was produced. But, for reasons about to be assigned and which are gleaned from Prof. Leidy's own statements, it appears in the highest degree improbable that the "square plates" in *Quadrula* can be truly described as being "composed of chitinoid membrane"—if we are to understand the term "*chitinoid*" in the sense in which he applies it to the tests of certain varieties of *Nebela* and *Hyalosphenia*, namely, as being exclusively composed of hardened sarcode altogether unconsolidated by any mineral ingredient which has entered into colloidal combination with it. Thus Prof. Leidy describes the test of "*Hyalosphenia cuneata*," a member of another very inter-

* The word "*thin*" was, by a mistake of mine, omitted at p. 332 of the 'Annals' for November, line 2 from bottom.

esting group of testaceous Amœbans, as consisting "of delicate, transparent and colourless chitinoid membrane, without trace of definite structure." In "*Hyalosphenia tincta*" and "*H. papilio*" the tests are said to be pale yellow. I have never to my knowledge fallen in with *Hyalosphenia*, but am nevertheless able to attest the occurrence of equally delicate chitinoid tests as occurring in one of the commonest forms when developed under favouring conditions, namely *Arcella vulgaris.*

But Prof. Leidy's view appears improbable for another and more substantial reason. It is this, that although the plates of *Quadrula* are described as above in the letterpress, there is not in any of the six figures (nos. 20 to 25) of plate xxiv. of his work, representing different views and forms of the kind of tests referred to, a single plate that even conveys the idea of having been intended to represent a true rectangular figure. On the contrary, with the exception of perhaps five or six plates out of some two hundred and fifty which nearly answer to the description of being square, all are more or less irregular both in their outlines and angles, and in these respects yield no such evidence of an approach to crystalline form *as is to be seen in some of the other tests represented in Prof. Leidy's work as belonging to true Difflugidæ.*

Moreover, nearly all the plates in the figures of *Quadrula* (pl. xxiv. figs. 20–25) are drawn as having more or less convex external surfaces, another character not met with in any specimens that have fallen under my notice. Indeed, it was the apparent perfect accuracy of the rectangles and the tabular surfaces and very definite margins of the plates in my specimens that led me to suspect their being due, in some degree at least, to crystalline agency, although I was fully alive to the fact that crystallization under ordinary circumstances is interfered with instead of being promoted in presence of colloids.

In Prof. Leidy's plate x. fig. 26, said to represent a shell of *Difflugia pyriformis*, composed "of *chitinoid membrane incorporated with thin siliceous plates*," some of these are really rectangular; but I should feel inclined to regard them as rectangular rods, as their length as compared with their width in most of the forms exhibiting them varies apparently from 4 to 1, to 10 or 12 to 1, or even more; the elongated form in such examples being in all likelihood the natural consequence of the siliceous constituent being derived from diatoms, many of which are of similar proportions. Some plates also, on "a shell of *D. arcula*, in pl. xv. fig. 36, and in figs. 16, 17, 18, and 19 of the same plate, representing *D. lobostoma*, are in

like manner rectangular. Again, in pl. xvi. fig. 22, representing *Difflugia globulosa*, we have a test described as being "composed of rectangular plates, together with a few * diatoms." This is a most interesting specimen, inasmuch as the entire external surface of the test (an oblate spheroid) is closely studded over with rectangular elongated plates, a broadly ovate valve of a diatom (apparently a *Cocconeis*) being faintly visible as adherent to the exterior of the plates, though so hyaline as not to obscure the plates on the part of the test covered by it. This form must be regarded not as a transitional variety between *Difflugia symmetrica* and those forms of test made up of an admixture of metamorphic bodies (such as were stated to be present on the test figured in Prof. Leidy's plate x. fig. 26, *suprà*), but as a form which is essentially a *second* "representative" of the so-called genus *Quadrula*, and is actually inserted in a plate devoted exclusively to six forms of *Difflugia*, viz. *globulosa*, *lobostoma*, *arcula*, *urceolata*, *cratera*, and *pyriformis*. To deny this because the figure of one is "pyriform compressed," whereas the other is a compressed spheroid, or because the rectangular plates in one are true squares, whereas in the others they are parallelograms, or even because in *Difflugia symmetrica* there is a close approach to symmetrical arrangement of the square plates, whereas in the other the elongated rectangular plates are not so symmetrically arranged, would be too absurd, when it is borne in mind that we are discussing the predominating characteristic so conspicuously manifest throughout the whole of the vast series of testaceous Rhizopods, namely an infinite tendency to variation—a tendency which even Prof. Leidy himself admits while making a new genus out of *Difflugia symmetrica*. The only matter for surprise is that so keen an observer as Prof. Leidy should not, at the first glance, have detected the intimate connexion just indicated between "*Quadrula*" and the specimen of *Difflugia globulosa* to which I refer. Curiously enough, Prof. Leidy figures, side by side with this specimen of *D. globulosa*, a second specimen of the same form (fig. 21), almost identical in size and quite identical in figure, in which there are no rectangular plates or disks of any kind, but the entire test is covered with diatoms as large as the *Cocconeis* in fig. 22. The diatoms in fig. 21 are, however, pointed ellipses, and they are as yet metamorphosed only to the extent of obliterating their generally very coarse striation or cellulation, another significant circumstance in

* Only *one* diatom-valve is visible on the test in fig. 22. There must therefore be some inaccuracy in the explanatory note.

this case and also in that of the single *Cocconeis* valve, which, however, still exhibits the median line and its nodules.

In plate xxii., representing *Nebela collaris*, figs. 13, 18, 19, and 20 (the two last "magnified 850 diameters"), are to be seen perfectly rectangular rods (called "linear *plates*" in the descriptive note), together with oval and round plates of various sizes, the larger ones exhibiting the curves of oval and circular diatom-valves. The two highly magnified figures (19 and 20) show the perfect angles of the rectangular plates and the tabular surface of the ovate and circular ones. But the most important piece of evidence is furnished by the test (fig. 18), described as "shell of narrow rectangular and oval plates, from which a broad strip was broken away, *showing that the fracture follows the intervals of the plates*." It must be remembered that the test is a large one, and the fractured aperture extends diagonally nearly from its apex to its base, not a single plate appearing to be broken across, but the irregular outline consisting of zigzags, each of which answers *pro tanto* to a side or end view of the plates. Hence we may reasonably assume that the whole of these plates are identical with the plates of *Difflugia symmetrica* in being perfectly rigid, strong enough not to yield to considerable force, and therefore necessarily composed of a large percentage of siliceous or other mineral matter in combination with the colloidal basis of the test.

But the nearest approach to the perfectly square figure of the plates in *Difflugia symmetrica* occurs in a specimen of *Nebela flabellulum*, represented in plate xxiii. fig. 19, a broad balloon-shaped variety, on the front of which there are eight perfectly-formed "*square plates*" scattered irregularly among a crowd of "circular, oval, and linear plates." In size and appearance the square plates exactly resemble those of *D. symmetrica*. Prof. Leidy (at p. 153) remarks:—"Occasionally I have found specimens in which *quadrate plates, like those of Quadrula symmetrica*, were mingled with the more usual structural elements as seen in fig. 19," *i. e.* in the figure I have been referring to. Nevertheless, we know Prof. Leidy has in his definition of "*Quadrula*" declared that the test is "composed of thin square plates of *chitinoid membrane*," apparently forgetful of the following very circumstantial statement made by him in reference to *Nebela collaris*, the very form in which '*the quadrate plates, like those of Quadrula symmetrica*,' occasionally occur."

"In breaking the shell," he observes, "the line of rupture follows the outlines or intervals of the disks and plates. The shell [of *Nebela collaris*] *appears to be silicious, as it remains unchanged when exposed to the action of heated sulphuric and*

nitric acids " !—*Op. cit.* p. 151. Indisputable proof being here afforded by Prof. Leidy of these disks and plates being siliceous, was it wise to assert that those in *Difflugia symmetrica* are merely composed of chitinoid membrane?

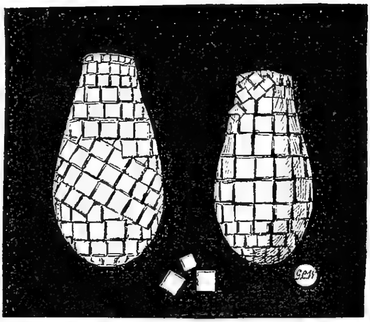
It now only remains for me, before passing on from the question of the generic status of *Difflugia symmetrica*, based on the figure and composition of its test, to draw attention to two or three collateral questions bearing upon what has gone before. The first relates to a very interesting experiment made by me with a view to find if rectangular plates resembling those on its test could be produced artificially. The experiment was eminently successful. It consisted in placing in a suitable phial finely pulverized organic silica in the form of "tabasheer" (a substance well known as a product formed within the joints of the bamboo) with an alkali and a mixture of glycerine, gum, the albumen of egg, potassium chlorate, and, lastly, distilled water, the alkali in solution being kept apart from the rest of the ingredients by a parchment diaphragm, and some cotton wool being placed loosely at the bottom of the phial for any crystalline or other formation to form or subside on. The phial and its contents were kept, at the ordinary atmospheric temperature of summer, in a glazed bookcase, where they could be examined without being in anywise disturbed. After about five weeks, to my intense satisfaction, distinct rectangular (square) plates were visible with a powerful pocket-lens, having already attained a size as large as the medium-sized plates usually found in *Difflugia symmetrica*, and in every respect resembling them. I would add that I did not attempt to follow any precise quantitative formula, but simply went by "the rule of thumb," looking on the first effort as merely tentative and likely to give me some clue to more accurate measurements on a future occasion. I do not doubt, therefore, that any chemist would be able to repeat the experiment with perfect success and without the least difficulty. Of course I cannot but regard the experiment as bearing in a very important degree on the validity of my hypothesis regarding the colloidal metamorphism observable in the plates and disks of the more marked forms, and the chitinous pellets and cylinders observable on the tests of the less highly metamorphosed forms, such as *D. spiralis* and others.

As regards Prof. Leidy's remark that the plates in *Difflugia symmetrica* are not so symmetrically arranged as the name would imply, I have only to state that although I unquestionably employed the term to indicate the arrangement of the plates in regular series, I also applied it to the perfect mathematical figure of the plates themselves.

That any real disregard for accuracy was manifest in employing the specific name *symmetrica* I deny, for if such hypercritical accuracy were indispensable in treating of such organisms as the tests of the Rhizopods, some of Prof. Leidy's statements, such, for example, as that about the "chitinoid membrane," would, I fancy, not fail to invoke some rather more hypercritical. But, apart from this, I maintain that every one of the specimens I have ever seen indicates all that is needed to justify the term *symmetrica*, inasmuch as tendency towards a definite and symmetrical arrangement is perfectly clear, the deviation from symmetry being obviously the result of accident rather than inherent tendency. And we must not ignore the fact, for it is a fact, that the cases are almost always exceptional in the organic world in which perfect symmetry is observable, the honeycomb being one of the most familiar examples. But what then? The bee is only the tool working out a figure which is controlled and directed by other physical forces and tendencies than those that are inherent in it. And so it is, I contend, with those "thin square plates of chitinoid membrane," which nevertheless happen to be silicious and able to withstand heated acids.

The two figures here given of *Difflugia symmetrica,* though somewhat roughly drawn, are nevertheless sufficiently accurate representations of the specimens from which they were taken. In the larger test it was my desire to show how accidentally applied disturbing causes, whether operating from without, or disturbance caused by the pseudopodia or chitinosarc of the animal, may occasionally break the regularity of the serial order of the plates. In no specimen have I ever seen a truncate angle; and where there has been any overlapping of plates its character has plainly pointed to disturbance of some sort acting from without. Both figures, I venture to think, inculcate this lesson. The three separate plates convey a fairly correct idea of their symmetrical form.

Fig. 1.



At p. 151 of his work Prof. Leidy says:—"Dr. Wallich, referring to the structure of the transitional forms of *Difflugia symmetrica*, which, as previously intimated, I suspect to

belong to *Nebela collaris*, calls the peculiar elements colloid disks and plates. He remarks that they are derived from the animal, and not directly from the medium in which it lives. He supposes, however, that they are formed through the coalescence of diatoms and other mineral elements with the chitinoid basal substance of the shell, which then undergo metamorphosis into all the colloid forms that occur."

Before proceeding with my observations on the "*Nebelæ*" I must make some comments upon the above statement in relation to the whole of the series of transitional and metamorphic forms referred by me to the genus *Difflugia*. The first point on which I lay emphasis is the extraordinary fact that this short paragraph contains nearly if not quite all the information Prof. Leidy has vouchsafed to publish concerning the *grounds* on which the conclusions in question were based. The second point is one upon which I would lay still greater emphasis, namely, the fact that, without any explanation whatever on Prof. Leidy's part, the whole of the metamorphic forms described and figured by me were bodily consigned, as in the case of *Difflugia symmetrica*, to a new genus. For, with exception of the short paragraph above quoted, from the first page of his work to the last, he has abstained from drawing attention to my reasons for maintaining that influences in nature extrinsic as regards the animal, serve in a principal degree to determine the external structure and constitution of the ectosarc of the naked Rhizopods, and notably the external structure and constitution of the tests of the testaceous forms.

On the other hand, he has several times gone out of his way to direct attention to conclusions of mine which he leaves it to be understood he considers erroneous, but which appear erroneous only because he has completely misrepresented them. That this is no exaggeration will be seen on reference to pp. 150 and 151 of his work, where, in the course of four-and-twenty lines, he gives the subjoined two versions of the same inaccurate statement in relation to the *Nebelæ*:—

"The series of specimens represented by Dr. Wallich in figs. 27 to 33, pl. xvi., vol. xiii. Ann. & Mag. Nat. Hist. for 1864, and described as transition forms of *Difflugia symmetrica*, appear to me to pertain to the same animal as *Nebela collaris*."

"Dr. Wallich, in referring to the structure of the shell of the transitional forms of *Difflugia symmetrica*, which, as previously intimated, I suspect to belong to *Nebela collaris*, calls the peculiar elements colloid disks and plates."

And yet a few pages before, namely at p. 145, he had already stated in his definition of the genus *Nebela*, that

"in form, constitution, and arrangement" the sarcode is as in DIFFLUGIA, &c.!

Had my facts and conclusions on the subject been controverted, or had sufficient reason been assigned for withholding them, the matter would have been intelligible. But no such case has been made out and no such reasons have been furnished. And what has been the result? Why, that during the last four years the forms specially constituting the subject of this paper have been mentioned in scientific works and journals in this country and abroad associated only with Prof. Leidy's name, and unaccompanied by any accurate characters of importance that had not been already assigned to them in papers published by me fifteen years previously.

In the bibliographical list appended to my name at the end of the letterpress of Prof. Leidy's work, the following is the sole reference to the transitional forms:—

"Transition forms, figs. 27 to 33 = NEBELA COLLARIS."

This line furnishes its own commentary *.

In these circumstances I must be permitted to furnish a somewhat fuller *résumé* of the facts upon which the conclusions were based which Prof. Leidy summarized as above, since they directly bear on the status of the *Nebelæ*. I must, however, preface what I have got to say by mentioning that, until very recently, I was unaware of the fact that Prof. Ehrenberg had described and figured an organism under the name of *Difflugia collaris*, which must in all probability have been one of Prof. Leidy's *Nebelæ*, in the 'Proceedings of the Berlin Academy' for 1848 (p. 218). But although very imperfectly described by the eminent German microscopist, no doubt owing to the imperfect lenses then available, his title to priority of discovery ought to be respected just as much as in the case of *Difflugia symmetrica*. Nevertheless this fact affects Prof. Leidy's views and mine on these two genera in very different ways. It adds another powerful reason, in addition to those already furnished, against the transfer of the forms included in them to newly created genera; in Prof. Leidy's case particularly, since his reference to Ehrenberg's

* The following errors and omissions in relation to the points under investigation occur in the text of Prof. Leidy's work. At p. 142, under *Quadrula*, reference is made to "*D. proteiformis*, var. *symmetrica*, 'Annals,' 1863, pl. x." It ought to be pl. viii.

At p. 145, under *Nebela*, reference made to *D. symmetrica*, Wallich, 'Annals,' vol. xiii. 1864, pl. xvi. figs. 27–33. No reference to text given, and no reference to paper of Dec. 1863, where same form is described.

In the same list appended to *Nebela* no reference at all is made to the "transition forms."

observations on this organism in the year 1848 show he was aware of Ehrenberg having discovered and drawn attention to the form in question (*vide* Leidy, p. 150). But it also adds another powerful reason to those I have already adduced why the transition forms referred by me to *Difflugia* should be retained in this genus*. It will be seen that Ehrenberg described the test as "*pyriform.*"

After having stated ('Annals,' May 1864) that no vegetable or extrinsically derived substances are, in my experience, employed for the consolidation of the Difflugian tests, I alluded to the selective faculty of the animals as being so remarkable that colourless mineral particles, sometimes quartzose, sometimes felspathic, sometimes micaceous, seem to be always chosen, as one or other of those minerals happens to be present in the mud of the locality inhabited by them, and that the particles are impacted into the chitinoid matrix in so workmanlike a manner as to leave only the smallest intervals between adjoining masses and as little overlapping as possible. Reference was next made to the fact that the testaceous forms when living in streamlets, where they incur a risk of being swept away, reduce this risk to a minimum by loading their tests with as large particles of mineral matter as they can utilize. It was also stated that the mineral particles used are not always of inorganic origin, diatoms of various kinds being promiscuously employed in some tests, whereas in others a selection has been made of one kind only out of the various forms present in the same habitat. And, finally, I remarked on the metamorphic forms of Difflugidæ, belonging for the most part to the mitriform and pyriform series, in which the chitinoid matrix of the tests presents no appreciable admixture with unmetamorphosed mineral matter, but is more or less closely covered over with composite bodies of various forms and sizes. The whole of the forms now referred to were minutely described as they present themselves to us in the metamorphic series, of which figures are given in the plate attached to my paper above referred to.

My reasons were then expressed for arriving at the conclusion that, except in the case of a few permanent varieties which present a type capable of being hereditarily transmitted, the whole of the varieties of Difflugian tests may be regarded as the result, first, of modifications in figure, dependent sometimes on the inability of the test to sustain its

* Ehrenberg's definition of *D. collaris* is as follows:—"*D. collaris*, n. sp. *D.* lorica sub ostio in colli formam attenuata, pyriformi, subclavata recta, superficie irregulariter *cellulosa* (!), cellulis parvis æqualibus, colli angustioribus, apertura integra" (Monatsb. 1848, p. 218).

own weight, and sometimes on the tendency to curvature or obliquity from the pressure of running water; secondly, of modifications in the materials of which the tests are constructed, sometimes depending on the kind of mineral substances procurable in particular localities, sometimes on a hitherto unrecognized and remarkable union between the chitinoid basal substance (which is an exudation from the animal) and the mineral particles, which that substance serves in the first instance merely to cement together; thirdly, of modifications in size, depending probably on the age, the perfect or imperfect nutrition of the animal, and also on the capability of the test to alter its form after having become consolidated to a certain extent by addition of mineral matter; fourthly, and lastly, of modifications in colour, arising partly from the nature of the food taken by the animal, partly from the external incrustation of organic or inorganic débris, and partly from the tint acquired by the chitinoid basal substance.

I next went on to state that the true nature of the rectangular plates of *Difflugia symmetrica* would become manifest as I proceeded with the description of the transitional forms that intervene between the most aberrant which is represented by *that form*, and the least aberrant form, viz. *Difflugia pyriformis* and its immediate varieties, which are represented by such very partially metamorphosed forms as are depicted in figs. 30 and 31 of the plate accompanying my paper. As already stated, in none of my papers on the subject of these Difflugidæ have the metamorphic series been described as transitional forms of *D. symmetrica*, as alleged by Prof. Leidy. On the contrary, in the explanatory notes annexed to pl. xvi. 'Annals,' March 1864, fig. 26 is thus described:—"*D. symmetrica*, showing the rectangular hyaline plates: *a*, form of aperture; *b*, a more compressed specimen, in which the aperture (*e*) is nearly closed; *d*, a few detached plates.

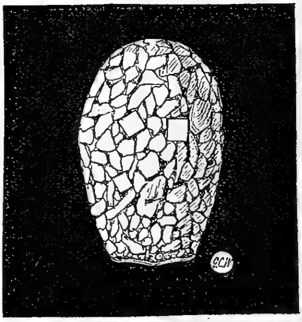
" Figs. 27 to 33 represent the series of forms *exhibiting the transition* from the ordinary mineral and chitinoid elements of the test to the evolution of the colloid disks."

And, lastly, in the explanatory remarks appended to pl. viii. of my paper in the 'Annals' for Dec. 1863, the following is the description given of fig. 16, pl. viii., p. 467:—" Test of *Difflugia pyriformis*, var. *symmetrica* (Wall.), showing symmetrical arrangement of the crystalline plates."

As some of the readers of the 'Annals' may not have access to the volumes for 1863 and 1864, in which typical figures of all the most remarkable Difflugian forms were given, I have been enabled through the courtesy of the editors to insert a few figures in illustration of special characters to

which I wish to draw attention in connexion with the forms to which reference has been made in the present and last month's instalment of this paper. The first figure in my list represents in outline one of the simplest and most common forms of Difflugian test, namely the mitriform—simplest because it approaches most closely to the spherical form (which there is reason to regard as the archetype of the entire Difflugian series) and constitutes also the earliest stage of most of the varieties of Difflugian tests which in the adult stage bear scarcely any resemblance to it: the tendency to variation in outline being, according to my view, neither resident in the animal nor in the test, *but in the varying external conditions*, which give the first impetus to change of figure when the young test has not as yet lost its purely membranous character, and is therefore still perfectly plastic. Once set in motion, the same external forces or influences (for some are really forces, whereas others are merely influences) continuing to act in the same direction naturally tend to stereotype and extend the characters first impressed on the young test. It is in this way, I contend, that whereas we have but one *type* of animal to deal with, we have an almost infinite *variety* of tests. It follows, therefore, that if we attempt to do more than group together the various most closely related varietal forms and kinds of test on some definite system based on a knowledge of the forces or influences which observation teaches us are the most effective agents in the results produced, we are simply the victims of an old-world illusion that may serve to amuse, but cannot instruct, those who indulge in it.

Fig. 2.

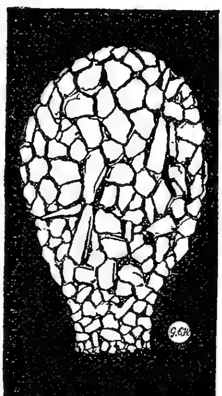


The annexed figure (fig. 2) must, for present purposes, be looked at without reference to the rectangular plates seen imbedded at its centre. As a matter of fact, this particular sketch was made to illustrate a point in connexion with *Difflugia symmetrica*, of which mention will be made presently. Apart, therefore, from the presence of those plates and a slight deviation from the original outline, which is by no means uncommon, the figure might represent a varietal form either of *D. mitriformis* or of *D. pyriformis*.

If we now take fig. 2 of *D. mitriformis* as we find it, with its admixture of rectangular plates, we shall recognize in the presence of the latter and the barely perceptible undulation at the margin of the mouth of the test, distinct evidence of metamorphism from the ordinary to the transitional type, of which (as has before been stated) *Difflugia symmetrica* is the *most pronounced and aberrant* variety. But I would particularly mention that, even as the figure stands, it was not selected to illustrate the earliest and most frequent aspect of metamorphism, of which a representation was given in fig. 30 of the series included in the 'Annals' plate of 1864, showing the whole of the small quartzose particles or minute diatom-valves plainly melting, as it were, into the substance of the chitinoid and colloid basis of the stratum on which they rest. The occurrence of these siliceous plates in the midst of insoluble mineral particles proves that they originate only in mineral substances capable of entering into colloidal combination with the chitinoid basis of the test. Hence they furnish clear evidence that there exists no intrinsic tendency in *Difflugia symmetrica* towards the development of these plates, which is not shared equally by the other varieties of the series. This, I venture to think, is confirmed by the specimens figured in Prof. Leidy's work to which attention has already been drawn in this paper.

Fig. 3 is a representation of the common form of *Difflugia pyriformis*, in which the massiveness of the angular mineral particles is such as to render them apparently proof against metamorphic agency. It will be seen on reference to the two figures of *Difflugia symmetrica* at p. 463, that they both partake of the pyriform curve, though never to a very marked extent—this being my reason for describing the figure of the test in *D. symmetrica* as corresponding most closely with *D. mitriformis*.

Fig. 3.



The two next sketches (figs. 4 and 5) represent very perfect specimens of highly-developed metamorphic forms, almost identical in every respect with those represented in figs. 32 and 33 of my 'Annals' series. Fig. 4 shows the test covered with round colloidal disks of nearly uniform size, placed in more or less regular order, but invariably resting upon their flat sur-

faces, the entire intervals being studded with much more minute disks or globules (for it is almost impossible to determine positively which they are). We have in this and also in fig. 5 typical examples of the pyriform test of *Difflugia pyriformis*, the only difference between them consisting in the degree of inflation in the body of the test—a difference which is shown to extend still further in pls. xxii. and xxiii. of "*Nebela collaris*" in Prof. Leidy's work. In fig. 5 (a Greenland form) very minute specimens of a diatom, probably an *Eunotia*, take the place of some of the colloid disks. It is, however, in the series of tests which are chiefly built up of diatoms that a clue is found to the formation of the large and small colloid disks, and rectangular siliceous plates derived from this source. In some tests the process of metamorphism can be very distinctly traced, and we then see in different specimens and different varieties a gradual passage from their original figure to one or other of the various metamorphic forms of which mention has been made. Where large oval or circular diatom-valves have formed part of the test these appear, in some of Prof. Leidy's figures, to pass eventually into true circular or oval hyaline plates of proportionately large dimensions.

Fig. 4.

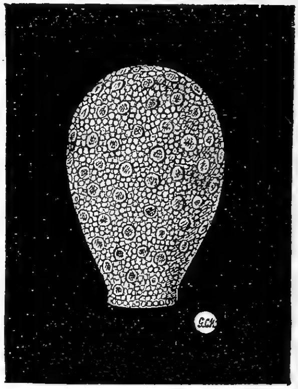
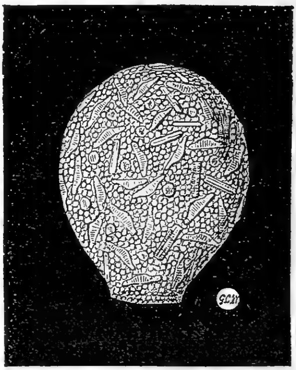


Fig. 5.



I have only space to add that the appearances described as characterizing the metamorphic series are not confined to the mitriform and pyriform varieties, though they would appear to reach their climax in them. They are likewise observable in the globular and oblique, or, as I have termed it, the marsupiiform series, of which *Difflugia spiralis* and *D. cassis* are offshoots. In the former of these two the chitinous pellets and cylinders, whether straight or bent, seem to arrive at their maximum of development. But, strange to say, I have never

met with a single example anywhere in which there occurred so close an approach to distinct siliceous rods and plates as is to be seen in pl. xix. of Prof. Leidy's series. I have nevertheless met with specimens of *D. cassis* in which there was a row of circular colloid disks surrounding the aperture of the test.

Before bringing my remarks on the Difflugian Rhizopods to a close, I must point out that, although Prof. Leidy has paid me the compliment of adopting nearly every fact and conclusion of mine in relation to the forms he has transferred to his new genus *Nebela*, the only direct reference made by him to my previous writings on these forms is contained in the following brief paragraph at p. 151 of his observations on the Nebelidæ; and even here the scope of the remark he is quoting is very materially impaired by his having cut short the sentence at the word "occur":—

"Dr. Wallich, in referring to the shell of the transitional forms of *Difflugia symmetrica*, calls the peculiar elements colloid disks and plates. He remarks of them that they are derived from the animal and not directly from the medium in which it lives. He supposes, however, that they are formed through the coalescence of diatoms and other mineral elements with the chitinoid basal substance of the shell, which then undergo metamorphosis into all the colloid forms that occur. Of this process I have been unable to satisfy myself; but the exceedingly varied specimens which have come under my notice, of shells composed of elements apparently intrinsic and of regular but widely different forms, of others apparently of extrinsic elements, regular and irregular, with many others of a transitional character, *would appear to justify the conclusion of Dr. Wallich*."—*Op. cit.* p. 151.

The sentence quoted from p. 234 of the 'Annals' for March 1864 concludes as follows:—"*from the first alteration in shape of the mineral particles themselves, to the development of the crystalline tablets which were first described.*"

The genus *Nebela* is thus defined by Prof. Leidy:—

"Shell usually compressed pyriform, transparent, colourless, with or without appendages, composed of cancellated membrane, or of peculiar intrinsic structural elements of variable form and size, mostly of circular or oval disks, of narrow rectangular plates or rods, or of thin, less regular, angular plates, often almost exclusively of one or the other, sometimes of two or more intermingled in variable proportions, sometimes of chitinoid membrane incorporated with more or less extrinsic elements, and sometimes of these entirely, as in *Difflugia*.

Mouth inferior, terminal, oval. *Sarcode colourless, in form, constitution, and arrangement as in* Difflugia, Hyalosphenia, &c."—*Op. cit.* p. 145.

"In composition the shell [of *Nebela collaris*] is of extraordinary character, from the variety in form and arrangement of its elements. Most frequently it is composed of oval or circular disks. The disks usually hold no relationship in size with that of the shell; . . . . sometimes the shell is almost entirely composed of circular disks, sometimes of oval disks, and frequently the two kinds are intermingled. Sometimes they are of pretty uniform size; at others, they are intermingled, of different sizes. Most frequently the larger disks occupy the fundus and body and the smaller ones the lower part or neck of the shell. Sometimes the larger disks are more or less scattered, with some approach to uniformity, and the intervals are occupied by smaller ones. Indeed, there exists almost any conceivable arrangement of the round and oval disks in the construction of the shell."—*Op. cit.* p. 147.

"Not unfrequently there are found, in association with the usual more characteristic varieties of *N. collaris*, *individuals which have the same form of shell, but with its structure rather related with that of the ordinary forms of Difflugia.* In some specimens the shell is composed of thin and irregularly angular silicious plates as represented in fig. 12."—*Op. cit.* p. 148.

"Sometimes narrow rectangular plates in different proportions are intermingled with the disks, and occasionally the former greatly predominate. Occasionally I have found specimens in which quadrate plates, like those of *Quadrula symmetrica*, were mingled with the more usual structural elements."—*Op. cit.* p. 153.

"The specimens vary greatly in the form of the component *silicious plates*, which consist of variable proportions of the kind just described, *with others which are more regularly rectangular*, or in the form of rods, and sometimes with diatoms and round or oval plates, like those which ordinarily compose the shell of *Nebela collaris*. *Through such specimens the latter would appear by transition forms to merge into* Difflugia compressa!"—*Op. cit.* p. 148.

"The nature of the singularly varied shell of *Nebela collaris* I have not been able to determine with any satisfaction. In the characteristic forms, the elements of structure, the disks and plates, appear to be intrinsic, and not of a foreign character. They appear to be cemented together or conjoined at the borders, and not implanted upon or incorporated with a distinct chitinoid membrane. In breaking the shell the line of frac-

ture follows the outline or intervals of the disks and plates. The shell appears to be silicious and remains unchanged when exposed to the action of heated sulphuric and nitric acids."—*Op. cit.* p. 151.

The encystation of the naked and testaceous Amœbans, the process of "coagulation" and "consolidation" of the ectosarc by which the membranous structure of the encysting sac is produced, the formation of the *diaphragm* by which the mouth of the testaceous Amœbans is closed during their encystation, and the characters each of these parts assume, will be found described by me in the 'Annals' for May 1863, pp. 367 to 369; 'Annals,' Nov. 1863, p. 336; 'Annals,' Dec. 1863, p. 462; and 'Annals,' March 1864, p. 235.

It only remains for me to say that more admirably and truthfully executed figures of the freshwater Rhizopods have never been issued than those contained in Prof. Leidy's work. In no other publication have such indisputable proofs ever been brought together of the process of natural evolution from one end to the other of a very extensive and complete series of Protozoan organisms. Had Prof. Leidy dwelt somewhat more fully and distinctly than he has done on this the most striking feature in his researches he would indeed have conferred benefits of no ordinary magnitude upon the branch of science of which he is so distinguished an expositor*.

XLIII.—*Descriptions of three new Species of* Geckos. By G. A. Boulenger.

Gecko pumilus, sp. n.

In habit similar to *Lepidodactylus Guppyi*. Head small, body elongate, limbs moderate. Snout once and one third the diameter of the orbit, which equals the distance between the latter and the very small, round ear-opening; forehead scarcely concave. Head covered with small granules, which are considerably larger on the snout; rostral quadrangular, not quite twice as broad as long, with a short cleft above; nostril pierced between the rostral, the first labial, and three nasals; twelve upper and ten lower labials; three or four

* I have but recently seen Mr. Romyn Hitchcock's "Synopsis" of Prof. Leidy's great work, and can confidently recommend it as a most useful compendium of information on the freshwater Rhizopods in general.

transverse rows of small hexagonal chin-shields. Dorsal scales uniform, minutely granular; ventrals much larger, roundish-hexagonal, subimbricate. Digits one third webbed, strongly dilated, with ten or eleven angularly curved lamellæ under the median toes. A short angular series of eleven præanal pores (merely indicated, the specimen being a female). Tail cylindrical, slightly depressed, covered with uniform small flat scales, largest inferiorly. Pale reddish brown above, brownish white inferiorly; a dark line on the loreal region; a few small black spots on the tail.

	millim.
Total length	84
Head	10
Width of head	5·5
Body	30
Fore limb	10
Hind limb	14
Tail	44

A single female specimen, from Murray Island, collected by the Rev. S. Macfarlane.

This species is so closely allied to those of the genus *Lepidodactylus* that the propriety of separating it from the latter appears to me somewhat doubtful. However, by its undivided infradigital lamellæ it agrees with the genus *Gecko*, as at present defined.

Homopholis macrolepis, sp. n.

Head oviform, depressed, its depth contained twice in its length; snout as long as the distance between the eye and the ear, scarcely longer than the diameter of the orbit; forehead and interorbital space concave; ear-opening small, roundish-subtriangular. Head covered with small granules, which are considerably larger on the snout; rostral six-sided, twice as broad as long, its three upper sides in contact with the anterior nasal and an internasal; nostril pierced between the rostral and six scales, the two anterior of which are the largest; eleven or twelve upper and eleven lower labials; none of the lower labials deeper than broad; mental small, trapezoid; a row of small chin-shields, the two median in contact with the mental. Dorsal scales larger than ventrals; about eighty-five scales round the middle of the body. Limbs as in *H. Wahlbergii*. Tail with imbricate scales as on the body, on the upper surface much smaller than on the lower. Uniform greyish above.

	millim.
Total length	170
Head	26
Width of head	20
Body	69
Fore limb	30
Hind limb	42
Tail	75

A single female specimen, from Delagoa Bay; presented by the South-African Museum, Cape Town.

Rhoptropus ocellatus, sp. n.

Head much depressed; snout broadly rounded, a little longer than the diameter of the orbit, as long as the distance between the latter and the ear; latter rather large, elliptical, oblique; forehead not concave. Head covered with flat granules, largest on the snout; rostral trapezoid, separating the nasals; nostril pierced between the first labial and two nasals; latter not swollen; seven upper and six lower labials; mental large, subtriangular, broader than long, in contact with two chin-shields; the chin-shields graduating into the smaller gular scales. Dorsal scales small, granular; ventrals much larger, roundish-hexagonal, imbricate. Limbs shorter than in *R. afer*; the adpressed hind limb reaches the axilla. Inner digit very short, not half the length of second. An uninterrupted series of thirty-one femoral and præanal pores in the male. Grey above, with round, dark-edged, whitish spots; a rather indistinct dark line on each side of the head, passing through the eye; lower surfaces whitish.

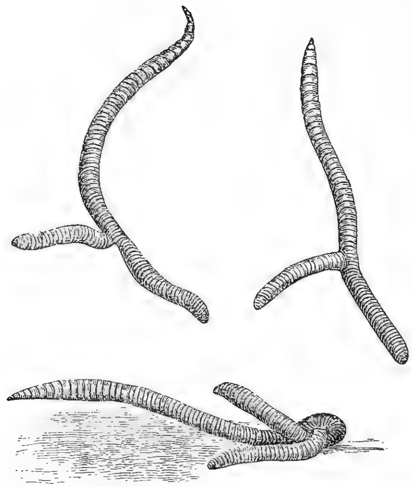
	millim.
From snout to vent	35
Head	11
Width of head	7
Fore limb	14
Hind limb	18

A single male specimen, from Cape Town; presented by the South-African Museum.

XLIV.—*Notice of two* Lumbrici *with bifid Hinder Ends.* By Prof. F. Jeffrey Bell, M.A.

On the 20th of June last Dr. Günther received from Dr. Kirkman, of Hastings, a small earthworm (*Lumbricus terrestris*) which was remarkable for having the hinder third of its body bifurcated. The figures now given are reproductions of the sketches made a few days later by Mr Mintern; they

exhibit the natural size of the worm, and the form it took when moving at ease. It will be observed that the left branch appears to be a little shorter than the right; and at



times this difference appeared to be better marked, so that an observer would frequently remark that the left branch looked like a bud. That it was not so was proved by this one fact, that, as time went on, the difference in size became more marked.

For more than two months the worm was under my care, and I sedulously attended and watched it.

On August 21 it was still very lively, and for the first time there were apparent some indications of a future clitellum, of which as yet there had been no sign; but even these were still obscure. There was now a very definite difference between the left- and the right-hand branches, the former being not only smaller but much less active.

On the 25th of August Mr. Hesse (the taxidermist to the Zoological Department, to whose charge I committed the worm during an absence from London) observed that the creature had lost its "tails," and on the 29th of August it was found dead.

On the 22nd of August Mr. Harting was kind enough to hand to me an example of a "brandling" (*Lumbricus fœtidus*) which had been forwarded to him by Mr. Robert Service, of

Maxwelltown, Dumfries, on account of "its bifurcated tail;" this specimen was dead, and was unfortunately sent dry.

The only specimen known to me which presents a similar arrangement of the hinder end of the body is in the Anatomical Department of the University Museum at Oxford, a short notice of which was published by Mr. Charles Robertson in 1867*.

The specimen having died after losing its "tails," and the portions having been lost during my absence from London, there has been no opportunity of making an anatomical investigation; had I done so I should, I am sure, have found the dorsal blood-vessel dividing into equal branches at the point of bifurcation, and I should, I think, have found the enteric tract in the right half a little larger than that in the left.

My primary object in this notice is to put on record an occurrence which, it is possible, is not very rare, but which has, at least, escaped general observation. It can be but matter of guesswork what was the nature of the accident that preceded the appearance of the bifurcated end; it is almost as hard to see exactly what the phenomenon does teach us:—

1. It makes it quite certain that, like lizards with their tails, earthworms may reproduce bilaterally what is ordinarily only produced terminally. But this is only another way of saying that earthworms are subject to a well-known and widely diffused "law."

2. The fact that the clitellum only became apparent a few days before the loss of the hinder end is positive; but the events may or may not have any relation to one another. If they have, they only show that when the earthworm is reproducing parts of its body it is, *pro tanto*, comparable to a form reproducing itself asexually, a phenomenon which, so high in the scale of organization, is, we know, not compatible or contemporaneous with sexual reproduction.

XLV.—*Trachelius ovum*. By Sara Gwendolen Foulke†.

In first describing this Infusorian, Ehrenberg attributed to it the possession of a much ramified œsophageal canal; but his view, subsequently upheld by Claparède and Lachmann, has been strongly opposed by W. Saville Kent, who claims that the so-called alimentary canal is merely the granular protoplasm

* Quarterly Journal Microsc. Sci. vii. (1867), p. 157. I am indebted to Mr. Robertson for this reference.

† From the 'Journal of the New York Microscopical Society.'

highly vacuolate. My own observations had coincided with those of Mr. Kent, and recently strong confirmation of his opinion was obtained from the following phenomena:—

I had taken from a *Chara*-bog numbers of *Trachelii.* Their unusually large size—one fortieth of an inch—afforded special advantages for observation. In colour the specimens were a transparent creamy yellow. When first removed to the live-box they uniformly showed the ventral side to be flattened and deeply indented longitudinally, so that a transverse section would be kidney-shaped. After a confinement of some minutes they became globose in contour, and thus they remained during captivity; but when they were set free the indentation soon reappeared. In one specimen the granular reticulation, at first finely shown, seemed to become less profusely ramified, and a current of the protoplasm towards the central mass was noticed. This flow continued until all the smaller branches were massed at a subcentral point, leaving the rest of the body apparently hollow. One pseudopodium-like process was now sent to a more posterior point in the periphery, and the flow was resumed, this time outwards, until the protoplasm was collected into a nodule attached to the cell-wall, along which a small portion flowed, afterwards remaining motionless. No nucleus could be detected in this specimen, though present in all others examined.

The above condition remained unchanged for nearly an hour, when, wishing to test the apparent hollowness of the cell, I removed from the live-box all but a small portion of the water, and pressed the *Trachelius* with a blunt knife-blade. Complete collapse ensued, and the animal now resembled a twisted rag.

It seemed, however, nowise injured by the operation, as, after about six hours passed at the edge of the water, it resumed its globose shape, and free motion about the live-box again began.

An accident prevented further investigation, but, from the diffused condition of the nucleus, incipient reproductive phenomena were suspected.

In this connexion I should like to draw attention to a form described by me in a communication to the Academy of Natural Sciences of Philadelphia, March 4th, 1884, under the name of *Trachelius Leidyi.* The distinction then made with regard to shape having been rendered invalid by the observations above noted, colour and the more profuse vacuolation of the periphery alone remain, and, regarding these as insufficient differences, I have decided to withdraw the species.

XLVI.—*Description of the Marsupial Egg of* Echidna hystrix. By Edward P. Ramsay, Esq., F.L.S., C.M.Z.S.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—

Since the publication in the Ann. & Mag. Nat. Hist. No. 84, December 1884, of the "Description of an Impregnated Uterus and of the Uterine Ova of *Echidna hystrix*," I have been favoured with a letter, dated "Australian Museum, Sydney, September 14th, 1885," from my valued correspondent Edward P. Ramsay, Esq., F.L.S., Curator of that museum, with the following result of his researches on the same physiological subject.

Sheen Lodge, Richmond Park. Richard Owen.

"To-day [I presume the date of his letter] I got another fine female *Echidna*: I now have four. On examining her pouch I found therein *an egg*, white in colour and about half an inch in length, having a rather tough skin, with, I fancy, very little lime in it, and very like that of a reptile. It is oval, equally rounded at either end. The beast showed great resentment at being examined, and, being a very prickly subject, I had not much time to examine the egg, as I was afraid of breaking it. The pouch was much warmer than the body of Echidnas generally. I was much surprised at the warmth when I put my fingers in. To-morrow I will take *the temperature*, and I think I will leave her to hatch out the young. I felt at first inclined to make a preparation of her and put her in spirits. The pouch *entirely disappears*, *or, rather, does not appear at all*, until the parent is about to lay her egg. I wish I could send her on to you just as she is. On placing her in a cask of sand she at once burrowed out of sight, covering herself with sand to a depth of 4 inches.

"The other specimens which I have also burrow and hide themselves in comparatively stiff soil. They go often down 4 to 5 feet in the night-time. We dig them out every second day or so, when we find they have gone too far.

"I hope to be able to make some observations on the length of time in hatching. Other females which I have have no eggs in the pouch. They feed freely on fresh milk, sweetened with a little sugar, and some bread-crumbs added. Some become tame very soon, and come readily for their milk; others will not drink except when one is out of sight."

(A description of the mammary pouches and mammary fœtus is given in the 'Philosophical Transactions' for 1865, pp. 671–686, pls. xxxix.–xli.)

XLVII.—*Notes from the St. Andrews Marine Laboratory (under the Fishery Board for Scotland).* By Prof. M'Intosh, M.D., LL.D., F.R.S., &c.—No. III. *

[Plate XIII.]

1. On the Ova of *Callionymus lyra*, L.
2. On a new British *Staurocephalus.*
3. On certain Processes formed by *Cerapus* on *Tubularia indivisa.*
4. On Structures resembling Ova procured off the Forth.
5. On a Female Porpoise, with a note on its Milk.

1. On the Ova of *Callionymus lyra*, L.

So little was known about the breeding of this fish that the most recent work on British fishes, viz. that of Dr. Day †, contains nothing more than the following remark, the quotation of which will indicate how much remains to be done in this department:—" Dr. G. Johnston ‡ recorded having found a sordid dragonet containing milt or soft roe, it being a young male. The Rev. G. Harris § mentions having discovered hard roe in a gemmeous dragonet, which, provided the observations were correct, is interesting as seeming to show that the female might assume the colours of the male and still not be sterile. The observation does not seem to have been confirmed by any other naturalist." It will thus be observed that the author has nothing to advance in regard to the nature of the ova or spermatozoa, and nothing in regard to the period of spawning. Yet the skulpin is a very common fish on our eastern shores both in the trawl and on the lines of the fishermen, since it ranges from a few to 40 fathoms and upwards on sandy or muddy ground. It is perhaps less frequently brought on shore than other kinds of unsaleable fishes by either liners or trawlers, since the spinous rosette at the angle of the preoperculum causes general detestation; indeed, like the glutinous hag (*Myxine*), it is often jerked from the line into the sea by the fishermen or scooped overboard on a shovel by a trawler. In and near St. Andrews Bay they are frequently caught on the hooks of the liners (baited with mussels) when fishing for plaice and dabs as well as for haddocks; and I have to thank certain of the fishermen for this and similar opportunities of examining marine specimens.

* Communicated by the Author, having been read at the Aberdeen Meeting of the British Association (Section D), 1885.

† 'Fishes of Great Britain,' i. p. 176.

‡ Zool. Journ. iii. p. 336.

§ Zool. pp. 2999 and 3118.

A careful watch had been kept on the species throughout the spring; but it was not till the 12th of June that Mr. Prince, in my absence, procured a female with the ovaries so advanced as to give reliable data with regard to the eggs. Other females in a more or less developed condition were procured in July. In these the total bulk of the ovaries is by no means noteworthy, even at the breeding-season. They form a somewhat cordate mass, bifid in front, but connate posteriorly, and, like the spermaries, have a coating of the silvery peritoneal lining on the surface. Some of the ova were transparent, and thus, though small (·025 to ·03 inch in diameter), appeared to be mature. In their very early condition in the stroma of the ovaries these ova present a characteristic appearance (Pl. XIII. fig. 3), for shortly after passing from the stage of a mere nucleated cell the egg appears to have a double capsule (Pl. XIII. fig. 4), viz. an inner clear coat probably homologous with the *zona radiata* of other Teleosteans, and an outer one of beautifully-arranged hexagonal cells. The two divisions just mentioned, however, belong to one layer, as shown in sections made by Mr. Prince.

About a week later (8th August) a female with more fully-developed eggs was procured; indeed, the specimen seemed to have deposited part of its ova, some of which lay externally around the reproductive aperture. From the pellucid appearance of the eggs in various specimens it formerly appeared probable that they were pelagic, and the condition in this example cleared up any doubts. The translucent ova are very small, nearly approaching those of the common dab in this respect, and thus a very large number are held even by the small ovaries. When mature each ovum (Pl. XIII. fig. 1) has a very fine hyaline *zona radiata*, with a series for the most part of hexagonal reticulations like those of a honeycomb. These spaces are not quite uniform in size, but many are. Some again have four, six, and seven sides. When the edge of the sphere is examined the septa bounding the reticulations stand out very distinctly, and their edges show minute striæ (Pl. XIII. fig. 2). In transverse section of the partially developed egg in the ovary (Pl. XIII. fig. 4) the thickness of the *zona radiata* is in marked contrast with that in the fully mature ova. The external reticulations are imperfectly seen in preparations, as they form a confused layer from collapse. The exact function of this arrangement is unknown, but it enables the egg to be distinguished at once amongst its congeners.

So far as observed, a considerable number of ova, propor-

tionally to the size of the ovaries, seem to arrive at maturity simultaneously.

The mussels used as bait were found in the stomachs of several, while in the intestine *Trophon*, hermit-crabs, and fragments of bivalve mollusks occurred.

2. *On a new British* Staurocephalus (Staurocephalus Siberti).

When at Whitstable, in June 1884, I noticed in a small aquarium belonging to Mr. Sibert Saunders a minute annelid in considerable numbers, and, as its form seemed unfamiliar, I got Mr. Saunders to forward some to the St. Andrews Laboratory, where they now are. The marine specimens in the aquarium had been procured from the Whitstable oyster-beds, in which Mr. Saunders has for many years taken a prominent interest, so that, in all probability, the species about to be described haunts the algæ and other growths attached to the shells of the oyster. It is very hardy in confinement, not only living but multiplying in a small aquarium, and bearing long journeys without loss.

This form (Pl. XIII. fig. 5), which measures about 8 or 9 millim. in length and about 1 millim. in breadth, including the bristles, is comparatively pale and semitranslucent, the internal organs, such as the blackish dental apparatus and the straw-coloured or greenish alimentary canal, being visible from the exterior. There are about thirty segments in the body, exclusive of those devoid of bristles, viz. the cephalic, buccal, first body-segment, and caudal. The tail is terminated by two long slender styles provided with palpocils.

The head is horseshoe-shaped, and marked along the anterior edge by a series of palpocils, which are of considerable proportional length. These organs are broad at the base, taper to a fine point, and apparently are of great tactile sensibility. Their motion along the anterior arch of the snout is so lively that the surface seems to be ciliated. On the dorsum of the præstomium in front of each anterior eye is a small tentacle of two segments, the basal shorter than the distal, which is bluntly rounded and furnished with palpocils similar to those on the anterior arch. A pair of tentacles having the same structure occupy a corresponding position on the ventral surface of the snout, but they are more external in position, so that they project distinctly on each side.

The number of eyes is variable; two are situated externally, each occupying a dimple behind the dorsal tentacle. They are simple pigment-spots, blackish by reflected and pale

brownish by transmitted light. The snout often shows a slight furrow nearly opposite each eye. On the summit of the præstomium, just in front of the nuchal fold, are a smaller pair of eyes placed near each other. Occasionally a pigment speck or two exist in front of these.

The armature of the proboscis (Pl. XIII. fig. 6) consists of a pair of dark brown or blackish, strongly curved, and sharp-pointed maxillæ, behind which an acute posterior process projects. Six denticles, which probably represent the dental plates of allied forms, occur beneath and in front of these, each having a somewhat hoof-shaped outline, the free edge anteriorly being finely denticulated. They diminish in size from before backward, the last having a long and slender process which reaches the posterior border of the maxillæ. The younger examples, as in the figure, have a smaller number of denticles. The mandibles have a process or tooth on the inner edge anteriorly, and the external region or spur is minutely crenate in front. The shafts are gently curved, like the letter *f*, and have a wing-like appendage immediately behind the anterior region.

Dorsally each foot presents a short cirrus, and ventrally a somewhat larger one. A long and conspicuous setigerous process occurs between these just above the ventral cirrus. The dorsal bristles (Pl. XIII. fig. 7) consist of two or three long and slightly curved simple bristles, the tips of which are somewhat flattened and slightly hooked. The ventral series are compound, the terminal pieces being apparently simple and slightly hooked (Pl. XIII. fig. 8). A strong spine supports the fleshy part of the foot.

At first sight it was supposed that the species just described corresponded with a form discovered by Prof. Langerhans in Madeira, and which he has termed *Staurocephalus minimus* *. The latter, however, appears to differ in the greater length (antero-posterior diameter) of the head and in the minute structure of the jaws and bristles. Thus the maxillæ in the foreign species wholly differ (if the figures of Langerhans are to be trusted) in appearance, and none of the pectinate processes he shows are to be found in the dental apparatus of *Staurocephalus Siberti*. So far as could be made out also the tips of both dorsal and ventral bristles are simply hooked and not bifid, as in the species from Madeira. Langerhans mentions that the *Lacydonia miranda* of Marion and Bobretzky †, from the Gulf of Lyons, presents certain resemblances to his

* Zeitschr. f. wiss. Zool. Bd. xl. p. 257, pl. xv. fig. 16.
† Ann. des Sc. Nat. 6e sér. ii. p. 57, pl. vii. fig. 17, &c

Staurocephalus minimus, though he observes that the armature of the proboscis in the latter at once distinguishes them. It appears to me, however, that these resemblances are quite superficial and probably have been suggested by the shape of the head. The position of the short cephalic tentacles, the structure of the proboscis, the form of the feet and the bristles, the structure of the segments following the head, and other particulars widely diverge, as indeed might be expected in a form approaching the Hesionidæ.

3. *On certain Processes formed by* Cerapus *on* Tubularia indivisa.

The members of the domicolous subdivision of the Amphipodous Crustacea are characterized by the very general habit of forming tubes of various kinds, which constitute dwellings as well as nests for the young, as in the common *Amphithoë* and in the *Podoceri*. Others, again, excavate tunnels in tough clay or mud, like *Corophium*, so abundant in the mussel-beds of the Eden, or perforate wood like *Chelura*. The subject of the present remarks, apparently a species of *Cerapus*, closely allied to *Cerapus difformis*, Milne-Edwards, and very prettily barred with red on the antennæ, constructs groups of flexible tubes (Pl. XIII. fig. 9, *a*, *a*), which vary in diameter according to the size of the occupant, on stems of *Tubularia indivisa*, very much as Stimpson describes in his *Cerapus rubricornis* on the shores of Grand Manan. Instead of being formed, however, as Stimpson says, of "fine mud and some animal cement," those of the British species have in addition grains of sand, bristles and spines of annelids, hairs of sea-mice, and many fine horny fibres, apparently derived from the byssi of horse-mussels.

On the same stems of *Tubularia* supporting the nests or tubes are certain remarkable processes (Pl. XIII. fig. 9, *b*, *b*) which project from the cœnœcium like branches, and, indeed, it was the unusual appearance and somewhat symmetrical arrangement of these that first attracted notice. These filamentous branches are of a dull greyish hue (that of the mud), and are very slightly tapered distally. The basal region, however, is distinctly larger, especially where fixed to the zoophyte. Their length varies from 3 to 4 inches, and all seemed incomplete. They are smoothly rounded and resemble the fine muddy tubes formed by certain annelids; but they are quite solid and composed of the same constituents as the tubes formerly mentioned, though, perhaps, the foreign bodies, such as bristles and spines, are more conspicuous. These, moreover, are neatly arranged with their long axis parallel to

that of the process, and especially abound towards the base of the filament, which thus is more rigid and tougher than the distal region, into the composition of which mud, sand, and the secretion chiefly enter. In consequence of this structure the distal region slightly curves downward in the ordinary position in the water, while the proximal stands stiffly outward. These processes are generally fixed to the main stem of the *Tubularia*, though occasionally they spring from the tip of a young example attached to the former, or stretch from the extremity of a parasitic Sertularian.

These filamentous processes are usually at some distance from the nests or tubes of the Crustaceans, which climb actively on them. Whether they thus give them a larger area for the capture of prey in security or afford a more extensive surface for the temporary arrest of minute larval or other forms on which they feed is unknown. It is probable, however, that processes so elaborate subserve some useful purpose to the species, and are not the result of mere purposeless formation by way of exercise.

Spinous processes of an equally peculiar kind are not uncommon on the tubes of annelids, such as those of *Nothria Willemoesii* and certain Terebellidæ discovered by the 'Challenger.' Most of these, however, have a protective function, whereas the foregoing processes cannot have this use assigned them.

4. *On certain Structures resembling Ova procured off the Forth.*

When carrying out the work for H.M. Commission on Trawling an old willow basket came up in the net on the 15th August, 1884, 15 miles S.E. of the island of May, which, besides other interesting marine forms, had attached to it certain peculiar dull yellowish structures resembling ova, and about $\frac{1}{8}$ inch in diameter (Pl. XIII. fig. 10). They adhered to each other, forming a group in a single layer along the bark of the twig. They are nearly circular, with a short, slightly curved distal process. The capsule is yielding, but tolerably tough, and the contents consist of a structureless soft and cohesive gelatinous substance of a pale colour. They were kept for a considerable time in the marine laboratory of St. Andrews, but no change ensued until decomposition set in.

5. *Note on a Female Porpoise and its Milk.*

Amongst the porpoises examined during the year at the marine laboratory was a fine adult female abounding in milk. For some days before its capture, in August, a solitary adult

individual had been noticed disporting itself in circles close to the commencement of the East Rocks, and it is possible that this was the specimen (5 feet 2 inches in length) captured in the salmon-nets. It had evidently been suckling, and a small quantity of its milk was preserved for examination. The mammæ were very prominent on capture, projecting beyond the sulcus in each case, but in ten or twelve hours after death they had shrunk very considerably. The milk is of a dull yellowish colour and of the consistency of thick cream, so that it passed with difficulty through the neck of a bottle. In John Hunter's "Observations on the Structure of Whales"*, it is stated of this species that "the milk is very rich; for in that caught near Berkeley with its young one, the milk, which was tasted by Mr. Jenner and Mr. Ludlow, surgeon, at Sudbury, was rich, like cow's milk to which cream had been added." I have to thank my colleague, Prof. Purdie, for making the subjoined "Note on the Chemical Composition of the Milk of the Porpoise" from a small quantity collected chiefly from the reservoirs during the dissection †.

The specimen appeared to have been delivered at a comparatively recent period, so that the remarks in the last edition of 'Bell's British Quadrupeds' may be supplemented. It is stated that a female was found pregnant towards the end of the year; and again, that Mr. Jenyns found a female in May with a fully-formed young one. They probably produce their young chiefly in summer. In the stomach of the ex-

* I am indebted to Prof. Flower for drawing my attention to this paper. 'Works of John Hunter' (J. F. Palmer), vol. iv. p. 392, edited by Sir Richard Owen.

† "Prof. M'Intosh having kindly placed at my disposal a specimen of milk which he extracted from the mammæ of a porpoise, I have made an analysis of it, thinking that the results are not without interest.

	In 100 parts by weight.
Water	41·11
Fat	45·80
Caseine	11·19
Milk-sugar (?)	1·33
Mineral salts	0·57
	100·00

"The most remarkable point about the composition of the milk is the large percentage of fat it contains, a constituent of food which, I presume, the cetacean, from its mode of life, would require in larger proportion than ordinary mammals do. The milk was not of an inviting appearance, being of a yellow colour and thick consistency, and possessing a '*fishy*' smell. The specific gravity of the milk, in spite of its solid contents, differed little from that of water."

(Vide *Chemical News*, 2nd Oct. 1885.)

ample caught at St. Andrews was a mass consisting of a number of herrings, "small" whitings, and haddocks.

EXPLANATION OF PLATE XIII.

Fig. 1. Mature ovum of *Callionymus lyra*, L., somewhat darkly shaded, and slightly altered (from keeping) inferiorly. Magnified.
Fig. 2. Honeycomb-like arrangement of the surface of the same. More highly magnified.
Fig. 3. Immature egg of the same from the ovary. Magnified.
Fig. 4. Section of an immature ovum in the ovary. The areolated superficial layer of the zona radiata presents a confused appearance externally, from collapse in mounting.
Fig. 5. Young example of *Staurocephalus Siberti*, n. sp. The eyes are absent in this example. Enlarged.
Fig. 6. Dental apparatus of the foregoing. × 90 diam.
Fig. 7. Dorsal bristle of the same. × 350 diam.
Fig. 8. Ventral bristle. × 350 diam.
Fig. 9. Stem of *Tubularia indivisa* with crustacean nests (*a*,*a*) and filamentous processes (*b*, *b*) attached to the chitinous periderm. About natural size.
Fig. 10. Structures resembling ova attached to a fragment of willow. Slightly enlarged.

XLVIII.—*On the Nest and Development of* Gastrosteus spinachia *at the St. Andrews Marine Laboratory*. By EDWARD E. PRINCE.

[Plate XIV.]

A COMMUNICATION to the Biological Section of the British Association at its recent meeting embodied certain observations made during the past summer at the St. Andrews Marine Laboratory, and of this the present paper is an amplification. *Gastrosteus spinachia*, amongst the smaller Teleosteans occurring upon our coasts, is a very common though a highly interesting form. Various authors, Kupfer, Ransom, Möbius, and others, have treated of this or the allied freshwater species; but the notices of the nidification, development, &c. of the marine form are very fragmentary and incomplete.

During the summer of 1885 a large number of the nests of the fifteen-spined stickleback have been examined in the St. Andrews laboratory; the process of building has been watched and the early stages of development studied.

Towards the latter end of April and during the months of May and June these nests may be found in sheltered rock-pools, between tide-limits, and generally some distance from low-water mark, so that, as Dr. Day observes, "they may be left uncovered for two or three hours at a time."* They

* Hist. of Brit. Fishes, p. 248.

occur most frequently amongst sea-weeds fringing tidal pools, and of such marginal weeds they are constructed. Prof. Möbius states * that the nests vary from 2 to 3 inches (5 to 8 centims.) in diameter; but these dimensions are often exceeded, the size being very variable and depending on (1) the character of the materials employed, and (2) the number of fishes depositing their ova in a particular nest. It is remarkable that the eggs of more than one female may be deposited in a single nest. This actually took place in the tanks of the laboratory—a female taking possession of an old nest, which contained advanced ova, and upon completing oviposition in the lower part of the nest, the male immediately surrounded that portion with binding threads. That the number of ova in one nest is often greater than a single female produces has been noticed by many observers; and Couch, struck by their disproportionate bulk, said that it was "only to be explained by the well-known fact that the ova of fishes generally obtain an increase of bulk by the absorption of water after exclusion"†; but the enlargement of non-pelagic eggs with dense capsules is not sufficient to account for the phenomenon in question, and the explanation is to be found in the plurality of females resorting to a particular nest. The male fish, which is the nest-builder, often selects a growing mass of Fucus-fronds, projecting 8 or 10 inches from the rock, and having a diameter of 5 or 6 inches in the widest part (Pl. XIV. fig. 5). A bunch of more minute Algæ, e. g. *Ceramium*, *Corallina*, &c., may be chosen, and the nest assumes a less cylindrical and more spherical form, measuring from 3 to 5 inches in diameter. In the former case little labour is required in building, the male merely binding the fronds by delicate circumscribing threads, which pass round transversely to the long axis of the mass (Pl. XIV. fig. 5, *a, a*). In the latter case, in which softer and less coarse materials are used, much labour is involved, the growing tuft forming merely the basis upon which the gathered fragments of Algæ, *Ulva*, *Corallina officinalis*, Hydrozoa, &c. are woven; this heterogeneous collection of dead fragments being intermingled with the fronds of the living plant and secured by tenacious threads, so that a somewhat compact mass is formed (Pl. XIV. fig. 5). The nest is pendulous and, being firmly anchored, is swayed about by the movements of the tide. So compactly are the materials interwoven that it is often difficult to tear them asunder, though they are always so disposed as to leave interspaces which are enlarged into more capacious chambers by the

* *Vide* Note in Aug. part (1885) of this Journal, p. 153.
† Couch, Hist. of Fishes of Brit. Islands, vol. iii. p. 182.

motions of the fish, the snout being introduced and worked about until pocket-like cavities are formed, or the creature, as often happens, passes and repasses through the cavities with similar results. The thread-like material which binds the nest is a remarkable product. It is secreted by the male, is colourless, tenacious, of the consistency of mucilage when freshly extruded, and exhibits a delicate blue opalescence which disappears in two or three days, leaving the threads of a transparent grey or dirty-white colour. According to Möbius it is nitrogenous, as is shown by treating with acids and alkalies, and evidently a form of mucin peculiarly modified. Like normal mucin it is gelatinous and viscid in water, turning white like tallow on immersion in spirit. Carmine stains it deeply.

On examining the male at the breeding-season, the kidneys are seen to be considerably swollen, the enlargement being especially noticeable posteriorly (fig. 1 A). Sections of the kidneys reveal an altered condition of the sinuous tubules (fig. 1 A, *b*), the conical epithelial cells of which are swollen at their free ends and indefinite in outline. The nucleus of each cell is slightly displaced and occupies a more terminal position than in the normal condition. These epithelial cells are active in secreting the material used in constructing the nest. They perform the function, indeed, of cell-glands, and their secretion is carried by the uriniferous tubes to the outer ventral border of each kidney, where a large duct passes longitudinally. In cross section the ureters (Pl. XIV. fig. 1 A, *a*, *a*) are oval, and their capacity is very great at this time, the walls being of dense fibrous tissue lined with pavement epithelium. Both ureters emerge from the renal mass near the posterior end and, descending in a forward direction, become applied to the wall of the so-called urinary bladder, which at this point is somewhat attenuated, and, passing anteriorly, they open obliquely from without inwards into the bladder. This structure, it is unnecessary to say, is not morphologically connected with the urinary receptacle of higher Vertebrates, the lengthened course of the ureters, of which it is simply a dilated common portion, being due to its extraordinary development in the male stickleback. In a fish $5\frac{1}{4}$ inches in length it is about an inch long, and at its widest part $\frac{1}{5}$ inch in diameter. Situated on the right side of the abdominal cavity, immediately below the swim-bladder in the post-hepatic region, it has the form of a capacious pyriform sac, ending blindly anteriorly, and diminishing in circumference as it passes backwards (Pl. XIV. fig. 6, *a*). Before terminating posteriorly it describes a double curve,

crossing over the intestine from the right to the left side (Pl. XIV. fig. 6, *b*), and after a short parallel course passing on the ventral side of the intestine to the right side again (Pl. XIV. fig. 6, *c*), debouching behind the genital pore (Pl. XIV. fig. 6, *d*) into a urinogenital sinus, forming the posterior portion of a cloacal depression (Pl. XIV. fig. 6, *e*), into which also the anus opens (Pl. XIV. fig. 6, *f*). The wall of the bladder consists of two layers, an internal epithelium (Pl. XIV. fig. 1 B, *a*), which is readily detached, and a dense external connective layer (Pl. XIV. fig. 1 B, *b*), which thins out as the bladder enlarges anteriorly. Traces of an intermediate muscular layer appear posteriorly where the walls are extraordinarily thickened. The descending ureters (Pl. XIV. fig. 1 B, *c c*) approach opposite sides of the bladder, that on the left proceeding obliquely below the common duct of the *vasa deferentia*, and passing forward and merging in the walls of the bladder on the left side. This union is shown in the same transverse section which shows the union of the *vas deferens* of the left testis with that of the right. The course of the right ureter is shorter and more direct, as the bladder lies on that side of the abdominal cavity at this point. It coalesces with the right wall of the bladder precisely opposite the left ureter. As the bladder descends to cross the intestine inferiorly it twists, so that the left ureter is brought to the ventral side and the right ureter ascends to the dorsal side of the cervix of the bladder. Both return to the lateral position as the bladder crosses the intestine. The intestine now curves to the right, and the relations of the ureters become reversed, the right being below and the left rising to the dorsal side of the bladder. They increase rapidly in capacity, showing in cross section an extremely elliptical cavity, and as the bladder enlarges they pass obliquely into its chamber, their walls being continuous with the external layer of the bladder. Along this tortuous course the viscid secretion of the renal tubules reaches the bladder, where it is stored up. When first formed the secretion is simply a plastic jelly; but a fibrillar structure appears to rapidly develop in it. Indeed this appearance is assumed while the secretion is contained in the ureters. The epithelial cells of the urinary canals exert so actively the secreting function that the bladder becomes much distended by the accumulating mucus, and at length it flows slowly to the urinary aperture, where it emerges as a tenacious elastic thread which readily adheres to any external object on contact. It can hardly be doubted that this secretion can be extruded at pleasure, the walls of the bladder assisted by the abdominal

parietes being sufficient to effect this; but it is produced so abundantly that it also often appears to ooze out involuntarily. Male fishes may often be seen with a glistening, pendulous, conoid mass hanging from the urinary aperture, and increasing in size until it becomes detached. Such flask-shaped masses of mucus occur frequently in tanks where these fishes are confined and no opportunity is afforded for nest-building. When, however, an appropriate mass of sea-weeds has been selected by the male, the fish has merely to approach closely, so that the protruding mucus may adhere to a projecting frond, and by passing and repassing round the mass the weaving operation is accomplished *. Occasionally a rapid ejaculatory movement is observed, and it is interesting to note that the threads are not carelessly superposed, except when necessary for increasing the density of the nest, but are crossed at an angle by the varying movements of the fish, so that rhomboidal spaces are enclosed and a regular reticulum is thus produced (Pl. XIV. fig. 5).

Often the tightly-drawn thread snaps asunder, though its tenacity is extreme; the fibres then curl up and form a terminal pellet, many of which occur on the surface of the nest. As before remarked, the mucus is not merely a semi-solid plasm, but assumes a funicular character while in the ureters. If one of the cords binding a nest together be examined it will be found to consist of several strands, the cord itself measuring from ·0046 inch to ·0051 inch in diameter, and the constituent threads from ·0008 inch to ·00092 inch. These smaller threads again consist of fine homogeneous filaments, which adhere in parallel order. The parallel arrangement of the ultimate fibrils is very striking and quite characteristic (Pl. XIV. fig. 4).

On the completion of the nest the female deposits the ova in the various chambers (Pl. XIV. fig. 5, *b b*). The ovum is disproportionately large, viz. ·085 inch in diameter, rarely spheroidal, the form being generally an ellipsoid. The capsule does not harden for several hours, its soft tenacious nature, assisted by the ovarian fluid, causing the ova to adhere strongly together. Indeed, after being separated, these ova, when brought into contact again within a few hours, immediately cling firmly to each other. As just

* The interesting behaviour of the male fish at this time has been described by many observers. His solicitude for the safety of the ova, and especially for the young when hatched, is very remarkable: *vide* Ransom, this journal, vol. xvi. 1865, p. 449; also G. J. Romanes, 'Animal Intelligence,' pp. 243–245.

observed, this tenacity is increased by the fluid secreted by the ovary, which slowly hardens when exposed to sea-water, and the ova are bound strongly in irregular masses. They cannot be separated save by exerting some force, and distinct facets or scars upon the capsule mark the points of attachment to neighbouring ova. Small spaces are left between adjacent ova, and the mass thus possesses a porous or spongy character, a feature of great consequence, to which attention was first drawn by Prof. M'Intosh in the June part of this journal. In describing the ova of *Cottus bubalis* Dr. M'Intosh said, "All adhered firmly together, yet leaving a series of cavities, so that the whole mass, as in *Cyclopterus*, imbibes and retains water, a provision of importance in the case of eggs deposited near low-water mark" *. When newly extruded the ova exhibit a delicate pale-green hue, which, however, soon gives place to the characteristic translucent amber tint. The capsule is hyaline, very dense, and resistent, the thickness being ·0013 inch, and it is separable into lamellæ. In microscopic section from twenty-five to thirty strata can be distinguished, and upon roughly tearing the capsule the successive lamellæ are readily seen (Pl. XIV. fig. 2). The capsule is minutely punctured, the pits being arranged in parallel rows (Pl. XIV. fig. 2). The micropyle is very distinct, and exhibits the usual funnel-like form, bold striæ radiating from the external aperture and giving it a stellate outline when viewed from above. A large mass of pale yellow oil-globules are aggregated at the vegetative pole and maintain usually a position in the segment opposite the germinal pole. About two hours after fertilization the protoplasmic cap is formed, and cleavage proceeds in the usual manner, the 16-cell stage being completed about the twelfth hour. The morula is reached at the thirtieth hour, and the periblast is then boldly marked, though no nuclei are apparent. In cross section the usual triangular form of the periblast is seen. The disk occupies the under side of the deutoplasmic globe; but if the ovum be shifted so that the disk becomes uppermost, it occasionally remains in that position, or, as is usual, regains its normal position slowly, and apparently with difficulty, the oil-globules having little power to "right" the disk. Delicate filaments, often very numerous, connect the mass of globules with the under surface of the disk. Similar pseudopodial threads were noted in *Tinca* by E. van Beneden, and in *Gastrosteus aculeatus* and *G. pungitius* by Ransom.

* Ann. & Mag. Nat. Hist. June 1885, p. 433.

The course of development is very slow as compared with pelagic ova. It was not until the fourth day that nuclei became visible in the periblast, and the corneous layer differentiated from the "lower layer" cells. On the sixth day the marginal rim is defined and the embryonic scutum indicated, the embryonic thickening being also apparent about noon on that day, by which time the blastoderm invests barely one third of the yelk. By the eighth day two thirds of the yelk-surface are enveloped, and the blastoderm is somewhat depressed. The portion of the yelk-surface not yet invested is dotted (with some approach to regularity) with nuclei. Round each nucleus, which is multinucleolate, protoplasm gathers and sends out radiating pseudopodia. Large cells also occur and refringent particles are abundant. Meanwhile the cephalic portion of the embryo is increasing in thickness, so that the keel prominently projects on the ventral blastodermic surface; the optic vesicles are rudely indicated, and the neurochord is differentiated, growing down as the notochord appears; and before the close of the eighth day the mesoblastic plates are well defined. The blastoderm, external to the embryo, assumes a striking appearance, as clear vesicles can be discerned scattered numerously over it. These nuclei, possibly periblastic, have a rounded outline and exhibit several nucleoli. Epiboly continues during these changes, and on the twelfth day the closure of the blastopore is effected. Many of the nuclei just noted now approach each other and coalesce. Segmentation of the embryonic trunk proceeds rapidly, and on this day twelve protovertebræ are marked off. On the following day (the thirteenth) four more are segmented, the primitive optic vesicles are pushed in, and the lenses developed; the otocysts also appear; the nasal pits are distinguishable and the cranial divisions are rudely marked. By the fourteenth day the embryo has appreciably lengthened; Kupfer's vesicle (which appears just before the closure of the blastopore, and attains its maximum shortly after) still persists, though reduced in size; the cranial region is greatly advanced, an enteric strand of cells is being aggregated in the mid-ventral region, and nineteen protovertebræ can be counted. A pectoral swelling is visible, indicating the growing heart. This organ rapidly develops, and by the seventeenth day assumes its characteristic campanulate shape. By the dehiscence of the yelk and the splanchnic mesoblast of the embryo a chamber is formed round the heart. At this time the caudal end of the young becomes free, the embryonic fin passing as a median membrane along the dorsum round the termination of the tail, along the ventral ridge, to the anal

area. The eyes, in which the lenses are now fully formed, are faintly pigmented with black. Nuclei still persist over the blastoderm, probably periblastic, but they are much reduced in number. Before the close of the seventeenth day the heart pulsates, though slowly and irregularly; more rapidly, however, on the eighteenth, though no hæmal fluid is as yet visible.

On the nineteenth day a distinct circulation is active. The formation of circulatory channels on the yelk-surface is very readily seen, and coincides with Ryder's description of the embryo of *Apeltes* *. The venous end of the heart, as in all Teleosteans, is applied to the yelk-surface, and by an excavation in the latter a capacious sinus is formed, in which corpuscles are seen vibrating to and fro, with the cardiac pulsations, before a circulation has commenced. Whether these primitive corpuscles originate in the periblast was not determined; but it certainly is the case that periblast-cells are detached and pass with the hæmal fluid into the heart when the circulation is established. This accords with Ryder's contention (in common with Hoffman, C. Vogt, and others) that the blood is a derivative from the periblast.

The vascular trunks, ramifying over the vitellus, appear to be simple lacunæ hollowed out of the yelk-cortex. In addition to the circulation of the embryonic trunk proper, the subnotochordal, arterial, and the cardinal (venous) trunks (which extend no further than the root of the tail at this stage), there are a subintestinal vein, breaking up apparently in the liver, and two large vitelline vessels. Of the last-named, one emerges behind the heart and the other in the region of the hind gut, the alimentary canal as yet ending blindly. These two capacious vitelline trunks unite in the distal portion of the yelk and return by a common large vein, which is joined by numerous lesser trunks, until it reaches the pectoral region, where it pours its volume into the sinus communicating with the heart.

A complex network of blood-vessels, or, rather, of sinuous lacunæ, covers the deutoplasmic globe, and the early approach of the hatching stage is indicated. On the nineteenth day, indeed, the embryo is very restless, the tail being spasmodically flexed and straightened, and vigorous side-to-side movements are executed. The pigment of the eyes is more dense, though the trunk is comparatively free from pigment, a few non-stellate black spots merely occurring on the dorsum. The development of the liver and alimentary canal agrees with

* U.S. Fish Comm. Report, 1882, p. 543.

that of Teleosteans in general. The swim-bladder can be made out immediately beneath the notochord; but no anal or urinogenital structures can be clearly distinguished. By the twentieth day the heart has lost its simple tubular structure, and, as a thin-walled sac, is flexed upon itself; and on the twenty-first day the circulation is in vigorous action, a great volume of corpuscles surging through the yelk-trunks.

It is not proposed to make reference to the serial microscopic sections of embryos which were prepared during these observations, as space will not permit, and the preparations have not yet been completely worked out in the laboratory. It must suffice in this brief survey of the early stages of *Gastrosteus spinachia* to note that the embryos emerge at various dates from the twenty-fifth to the fortieth days after fertilization—this variation in series of ova deposited at the same date being due to their unequal rate of development, the more central ova being longer, and the external ova being more rapid in reaching maturity. The newly-hatched young are soon richly supplied with pigment, bright yellow spots being scattered over the surface of the trunk, especially the dorsum, and elaborate stellate black pigment-spots occurring on the dorsal and lateral regions. They are very vigorous and active, contrasting greatly with the frail embryos of our common food-fishes, whose ova are pelagic.

It may be noted that the temperature of the water in the tanks during these observations varied from 41° F. in May to 50° or 51° F. early in June. The unique situation of the St. Andrews Marine Laboratory and its natural conditions being unusually favourable for the development of the ova of marine fishes, the phenomena observed in the progress of *Gastrosteus spinachia* may be taken as almost normal.

P.S.—It is remarkable that, whereas in the freshwater sticklebacks the male during the breeding-season assumes brilliant colours, the pectoral and ventral region being of a bright scarlet tint, in the marine species no such distinguishing marks appear. Both sexes exhibit a similar marking. The male alone appears to construct the nest, and though female fishes, distended with eggs, often hover near during the building process, none were observed at St. Andrews to take any part in the work. The statement published by Heincke * that the male and female fishes build the nest is probably incorrect and due to the similarity of the hues of both sexes.

* 'Illustrirte Naturgeschichte d. Thiere' (Leipzig, 1882), p. 400.

EXPLANATION OF PLATE XIV.

Fig. 1. Transverse section (male *Gastrosteus sp.*) of renal mass, urinary bladder &c. *in situ*, × 150 diam. A, kidneys (coalesced portion): *a*, *a*, right and left ureters passing longitudinally along outer ventral borders of kidneys; *b*, urinary tubules, nuclei of epithelial cells indicated. B, urinary bladder, behind the cervix: *a*, epithelium; *b*, fibrous layer; *c*, *c*, right and left ureters (on opposite sides of bladder); *d*, contained thread-like secretion from kidneys; C, intestine; D, D′, testes.

Fig. 2. Fragment of hyaline capsule of ovum, showing the rows of pits and lamellæ, × 300.

Fig. 3. Ditto, in transverse section, showing numerous lamellæ, × 350.

Fig. 4. Portion of mucous secretion, showing funicular structure, × 350.

Fig. 5. Sketch of nest (diagrammatic), one third nat. size, the pockets containing ova exposed. *a*, *a*, transversely-arranged intersecting threads; *b*, *b*, masses of ova contained in the interspaces of nest.

Fig. 6. Dissection of male, showing viscera of posterior portion of abdominal cavity, about nat. size. *a*, enlarged urinary bladder; *b*, left flexure of ditto (cervix); *c*, right flexure of ditto (near posterior termination); *d*, genital pore; *e*, cloacal depression; *f*, anus; *g*, urinary aperture; *h*, alimentary canal; *i*, *i*, right and left testes; *j*, *j*, kidneys; *j* 1, ureters; *k*, swim-bladder.

XLIX.—*On the Genus* Fistulipora, *M'Coy, with Descriptions of several Species.* By H. Alleyne Nicholson, M.D., D.Sc., Regius Professor of Natural History in the University of Aberdeen, and Arthur H. Foord, F.G.S., late of the Geological Survey of Canada.

[Plates XV.–XVIII.]

Introduction.

In the course of our study of various species of *Fistulipora* a most interesting and suggestive structural feature has come under our observation. This consists of a very peculiar modification of the walls of the autopores*, which gives them quite a distinct *facies*, and as it appears to have an important bearing upon the question of the zoological affinities of the genus (and consequently upon that of the Monticuliporidæ in general) we shall describe it as minutely as possible.

* We avail ourselves of this opportunity to offer a few words of explanation to the reader with reference to this and other terms we have found it expedient to introduce in substitution for the older ones hitherto in use. The principal tubes in *Fistulipora* and other genera of the Monticuliporidæ have been called "large corallites," or simply "corallites;" the tubes or tubuli filling the interspaces among these received the name of "interstitial tubes;" while the minute tubuli situated at the angles of

In well-preserved specimens, with the aid of a lens, the autopores are seen to possess a strong fold or sinus on one side of the cell-aperture, raised above the general surface (woodcut, fig. 2). That this fold is not superficial is proved by the fact that it occurs at all levels in the corallum at which a section may be made. It is seen also in longitudinal sections throughout the whole length of the autopores. In a transverse section this fold imparts a trilobate or floriform

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junction, or in other parts of the thickness of the walls, of the other tubes were entitled "spiniform corallites" (H. Alleyne Nicholson, 'Palæozoic Corals,' Monticulipora, 1881, chap. ii.). Finding these terms inconvenient for purposes of description, we propose to substitute for them the following :—*Autopores* (="large corallites"), *Mesopores* (="interstitial tubes"), and *Acanthopores* (="spiniform corallites").

The term "corallites" will be used only in a general sense when referring to the tubes of which the colony is made up.

Fig. 1.

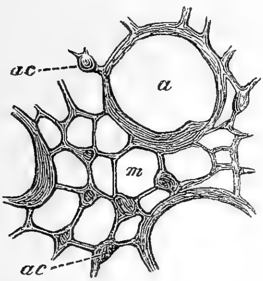


Fig. 2.

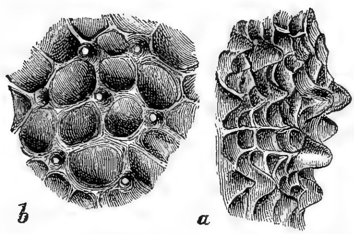


Fig. 1.—A few corallites of *F. eriensis*, Rom.: *a*, autopores; *m*, mesopores; *ac*, acanthopores. Enlarged about forty times.

Fig. 2.—*a*. Profile view of a portion of the surface of *Dekayia aspera*, Milne-Edw. & Haime (also one of the Monticuliporidæ), to show acanthopores; *b*, the same viewed from above. Enlarged about forty times.

There are two other words we shall have occasion to employ in the descriptions that follow; these are "monticules" and "maculæ." They have been used by one of the writers (*loc. cit.*) and by other authors to designate those minute areas or spots, either raised above the general surface of the corallum (monticules) or a little below it, or on a level with it (maculæ), which constitute the characteristic ornamentation of the Monticuliporidæ. It seems evident that these "maculæ" and "monticules" (consisting sometimes of cells larger than the average size of the corallites) are centres from which the growth of the colony proceeded. As illustrating this suggestion the reader is invited to look at the transverse section of *Fistulipora utriculus*, Rominger (Pl. XVI. fig. 1 *c*), which shows (in section) one of these spots, in this instance composed of mesopores; and the autopores, with their folds directed inwards, surrounding it. This condition of things subsists throughout the entire colony. Had the section been made larger it would have shown that similar areas occur adjacent to each other, thus presenting a series of "maculæ," around which the autopores range themselves in concentric rows.

aspect to the cells (Pl. XVI. fig. 1 *c*), interrupting the continuity of their outline and forming by its free ends two tooth-like projections in the interior of the cell. It will be noticed that the fold is of a lighter colour than the other part of the cell-wall. This lighter portion consists of crystalline calcite of a similar character to that of the matrix or infilling of the cells, though very slightly darker, while the remaining portion of the cell-wall and the walls of the mesopores are composed of a dense, granular, opaque calcite. This difference in the mineral composition in the two parts of the cell-wall must certainly have originated in the living tissues of the organism, because the same phenomenon is met with in species from such widely separated localities as Canada and Westphalia.

Concerning the morphological significance of the peculiar modification of the cell-wall we have just described, a valuable suggestion has been made to one of the writers by Prof. H. N. Moseley and Mr. G. B. Howes, after examining many specimens and sections of *Fistulipora*, to the effect that these structures may have formed a portion of the endo-skeleton supporting in the animal a ciliated groove (siphonoglyphe) similar to that which is found in the stomodæum of the Alcyonarians*.

This suggestion seems in our judgment to yield the only explanation which, in the present state of our knowledge, can be afforded in reference to this most interesting question. Some further observations upon it, however, appear to be needful.

We have seen that the folds in *Fistulipora* are present only in the autopores (=*autozooids* of the Alcyonarians?) and not in the mesopores (=*siphonozooids* of the Alcyonarians?). Their strong development in the former may be explained by supposing that the mesopores, becoming aborted, threw upon the autopores the task of supplying by their strong cilia the circulation of sea-water requisite for the nourishment of the colony. The peculiar condition of the mesopores in *Fistulipora* lends support to this view, as the close vesiculose tabulation which characterizes them would be difficult of explanation upon any other hypothesis.

With reference to the (assumed) occurrence of such a strongly marked ciliated groove in the autopores of the *Fistulipora*-colony it may be alleged that this is a somewhat rare condition to meet with in living Alcyonarians; but it is not altogether wanting in that group, for we find in the genus *Sarcophyton* (a dimorphic form) that the autozooids possess a

* Sydney J. Hickson, "On the Ciliated Groove (Siphonoglyphe) of the Stomodæum of the Alcyonarians," Phil. Trans. Royal Soc. part iii. 1883.

siphonoglyphe, though it is not so well marked as in the siphonozooids*.

We must not overlook the fact, however, that in *Sarcophyton* the siphonoglyphe is present only along the inner third of the stomodæum†, whereas in *Fistulipora* the fold, which we have assumed to have supported this ciliated groove, extends uninterruptedly throughout the entire length of the autopores, and, moreover, it appears upon the surface of the corallum in the form of a prominent arched lip in the apertures of those cells.

The occurrence of folds in the walls of the autopores of the *Fistuliporæ* has been observed by Dr. Rominger‡, of Ann Arbor, Michigan, who, however, does not appear to have attached any importance to it. Though unaccompanied by figures his descriptions are generally of sufficient exactness to enable the species to be identified. One of them, *Fistulipora utriculus*, is described and figured in this article. One of the writers has also noted and illustrated the structure in question in *Fistulipora incrassata* §. Mr. Ulrich of Cincinnati has published descriptions of a number of species of *Fistulipora*‖; but he makes no mention of folds in the walls of the autopores, the apertures of which he figures as rounded or oval in outline with more or less thickened margins. His omission of the folds in the autopores is not difficult to account for, as when not distinct they may be easily overlooked, especially in sections which have not been cut exactly at right angles to the longer axis of the corallites. The folds are represented, however, in an unmistakable manner in a figure Mr. Ulrich gives of *Lichenalia concentrica*, Hall¶, and they form the subject of some remarks upon the genus *Lichenalia*, which are here condensed. Mr. Ulrich proposes to eliminate from the genus *Fistulipora*, and place in *Lichenalia*, those species possessing "thin, lamellate, or bifoliate zoaria, and more or less distinctly bidenticulate apertures" [=folds]. As, however, *Fistulipora incrustans*, the type of the genus *Fistulipora*, possesses such "bidenticulate apertures" *as one of its most marked characters*, it is clear that Mr. Ulrich's proposal cannot be entertained, and that *Lichenalia*, as he has characterized it, is a *Fistulipora*.

It has now become necessary to give a new diagnosis of the genus *Fistulipora*, so as to introduce into it the peculiar structural features which we have been dwelling upon.

* *Loc. cit.* p. 695. † *Ibid.*

‡ Proc. Acad. Nat. Sci. Philadelphia, 1866, p. 113.

§ H. A. Nicholson, Pal. Tab. Corals, 1879, p. 308.

‖ Journ. Cincinnati Soc. Nat. Hist. vol. vii. April 1884, p. 43.

¶ *Loc. cit.* pl. iii. fig. 5.

Genus Fistulipora, M'Coy, 1849, emend. Nicholson & Foord.

Corallum variously shaped, dimorphic; consisting of two, more rarely of three, kinds of corallites; the first series (autopores) of a cylindrical or subcylindrical form with distinct walls, which on one side are thrown into two more or less well-developed longitudinal folds, giving to the cross section of the tube a characteristic trifoliate form. Apertures with raised margins, and prominent arched lips on one side corresponding with the folds. Tabulæ numerous, horizontal. The second series (mesopores) generally numerous, with imperfectly developed walls and very abundant tabulæ, which by their coalescence give rise to a vesicular tissue *. The third series (acanthopores), sometimes absent, consist of very minute tubuli, situated at the angles of junction, or in other parts of the thickness of the walls of the autopores and mesopores; they have distinct cells, are devoid of tabulæ, and project from the surface of the corallum in the form of blunt spines. No mural perforations.

Type: *Fistulipora incrustans*, Phillips, sp.

Fistulipora incrustans, Phill., sp.

Calamopora incrustans, Phillips, Geology of Yorkshire, part ii. p. 200, pl. i. figs. 63, 64 (1836).

Berenicea megastoma, M'Coy, Synopsis of the Carboniferous Fossils of Ireland, p. 195, pl. xxvi. fig. 13 (1844).

Fistulipora minor, M'Coy, Ann. & Mag. Nat. Hist. ser. 2, vol. iii. p. 130 (1849); id. Brit. Pal. Foss. p. 79 (1851).

Ceramopora megastoma, Vine, Quart. Journ. Geol. Soc. vol. xxxvi. p. 359, pl. xiii. (1880).

Ceramopora (*Berenicea*) *megastoma*, John Young, Ann. & Mag. Nat. Hist. ser. 5, vol. x. p. 427 (1882).

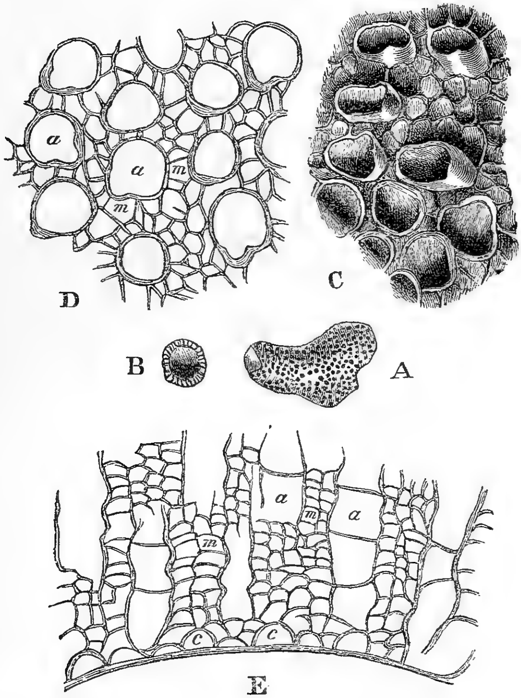
[Non *Fistulipora minor*, Nich. Pal. Tabulate Corals, p. 306 (1879).]

Spec. char. Corallum incrusting, growing upon the stems of Crinoids or other foreign bodies, and in the initial stages of growth taking the form of small circumscribed patches, often of a circular form. Adult crusts usually from 1 to 2 millimetres or more in thickness, the corallites being often more or less reclined in the young crusts, but becoming erect in old examples. The mode of growth is from definite centres (primitively one), from which the corallites radiate, and which ultimately constitute so many stellate "maculæ." The autopores average $\frac{1}{2}$ millim. in diameter, and are slightly but quite distinctly trifoliate in section. The apertures in well-preserved specimens show very clearly the arched lip, which depends upon the trifoliate form of the tubes. About three autopores occupy a space of $1\frac{1}{2}$ millim. (=to about fifty auto-

* See note p. 516.

pores in an inch). Acanthopores are wanting. The autopores are intersected by comparatively remote complete tabulæ. The mesopores are crossed by more closely-set tabulæ,

Fig. 3.



Fistulipora incrustans, Phill., sp. A. Fragment of the corallum of the natural size. B. Section of the same, to show vertical thickness. C. Portion of surface, showing the autopores with their raised lips, and the mesopores occupying the intervening spaces, enlarged about twenty times. D. Transverse section, similarly enlarged, showing fission in some of the mesopores. E. Longitudinal section, similarly enlarged: *a*, autopores; *m*, mesopores; *c*, primary cells.

which, owing to the incomplete nature of the walls of the mesopores, often give rise to a sort of vesicular tissue. The "maculæ" are composed wholly of mesopores.

Obs. As regards the *synonymy* of this species, we have examined the original specimen of the *Calamopora incrustans* of Phillips, from the Carboniferous Limestone, now preserved in the British Museum, and we are satisfied as to its identity with the Northumbrian and Scotch examples of *Fistulipora*

minor, M'Coy, the originals of which were also obtained from the Carboniferous Limestone. Phillips's specimen of *F. incrustans* is not well preserved, especially as regards its external surface; but we are not able to see in thin sections of it any characters which would in any way separate it from *F. minor*, M'Coy. Under these circumstances the species must stand as *Fistulipora incrustans*, Phill., sp., and M'Coy's name must hence be regarded as a synonym.

As to the propriety of ranking the fossil which M'Coy described (*loc. cit.*) under the name of *Berenicea megastoma*, as also a synonym of *Fistulipora incrustans*, we cannot speak with the same certainty, since we have had no opportunity of examining M'Coy's original specimen. There can, however, be no doubt that the fossil which has usually been identified (notably by Mr. Vine and Mr. John Young) with *Berenicea megastoma*, M'Coy, is truly the young stage of *Fistulipora incrustans*. Mr. John Young (*loc. cit.*) has fully demonstrated this point. Whether, however, the fossil usually identified with *Berenicea megastoma*, M'Coy, is really the fossil so named by M'Coy is a point which could only be positively decided by an examination of M'Coy's original example. We are, however, disposed to believe that the identification is correct, and we therefore place *Berenicea megastoma*, M'Coy, as a synonym of *F. incrustans*, Phill.

On the other hand, the Carboniferous coral described by one of us (Nicholson, Pal. Tab. Corals) under the name of *Fistulipora minor*, M'Coy, appears to be a distinct but closely-related species, to which we shall here give the name of *F. muscosa*. It does not differ essentially, however, from typical examples of *F. incrustans*, Phill. (=*F. minor*, M'Coy), in anything except the rather smaller dimensions of the autopores and the proportion which these bear to the mesopores.

The most distinctive characters of the minute structure of *F. incrustans* are the comparatively large size of the autopores and their being usually separated by no more than one or two rows of mesopores. The general shape of the autopores is oval or circular, and the trifoliate form of the tubes in cross section is not nearly so marked as it is in many species of *Fistulipora*, though it is quite commonly recognizable. That the autopores really have the form characteristic of the genus is shown not only by tangential sections, but also by an examination of the actual surface, many examples showing the peculiar arching of one side of the aperture of the autopores which is associated with this peculiar type of corallites.

F. incrustans shows clearly, as does its near ally *F. muscosa*, the interesting phenomenon of the increase of the mesopores

by fission. In tangential sections the mesopores often exhibit a septum-like process extending to a greater or less distance into the cavity of the tube. This phenomenon, so well known as occurring in the genus *Chætetes*, Fischer, is the result of the fissiparous development of the corallites. We have observed precisely similar phenomena in the mesopores of *Constellaria antheloidea*, Hall, and in the autopores of *Monotrypa pulchella*, E. & H. In our opinion this fissiparous mode of development is a strong argument in favour of the reference of these forms to the Actinozoa rather than to the Polyzoa.

In the earliest stages of growth *F. incrustans* forms thin subcircular crusts upon foreign bodies, each crust commencing with a single "macula," from which the corallites radiate. In the progress of growth fresh "maculæ" are formed, and the crust gradually spreads over the invested body. In older colonies the original crust becomes thicker by the gradual elongation of the corallites in a direction at right angles to the invested surface. Sometimes also there may be a temporary cessation of growth, and then a second layer of corallites is formed above the old one. At the point where the corallites are attached to the body which the colony invests they are slightly bent, in a fashion which occurs in all the Monticuliporidæ as also in all the Favositidæ, where the colony springs from an extended surface, whether this surface belong to an invested foreign body or whether it be the natural epitheca. The obliquity of the young corallites thus produced is rendered in *F. incrustans* apparently greater than it really is, owing to the arching of the lips of the aperture of the autopores on one side. As growth proceeds the corallites become, however, quite erect. Even in the youngest colonies the existence of both the autopores and the intervening mesopores may be recognized quite clearly. Nor is there any difference whatever in the internal structure of young and old colonies; the only distinction, in fact, between the earlier and the later stages being merely the slight obliquity of the corallites of the former.

There seems to be little doubt that the fossil which M'Coy described (*loc. cit.*) under the name of *Berenicea megastoma* was really a specimen of the young stage of *Fistulipora incrustans*. As before remarked, however, it is not possible to be absolutely certain of this without an examination of M'Coy's original specimen, especially as M'Coy's figure of *Berenicea megastoma* does not exhibit any mesopores, nor does his description of the species contain any allusion to the presence of "interstitial tubes."

Mr. John Young, in the paper previously cited, not only pointed out that the so-called *Berenicea megastoma* of M'Coy is really the young of *Fistulipora minor*, M'Coy, but also accepted Mr. Vine's reference of the fossil to the genus *Ceramopora*, Hall. In this we are unable to agree with Mr. Young, and we may briefly state the reasons which, in our opinion, render inadmissible the course he has adopted. In the first place, supposing it to be proved that the genera named respectively *Fistulipora* and *Ceramopora* by their founders were synonymous, it would be the genus *Fistulipora*, M'Coy, which would have to be retained, and *Ceramopora*, Hall, suppressed. This is a mere matter of priority, *Fistulipora*, M'Coy, having been founded in 1849, whereas *Ceramopora*, Hall, was not established until two years later (Pal. N. Y. vol. ii. 1851). Even, therefore, if we were able to accept Mr. Young's views on this point, the species now under consideration would still have to be placed under the generic title of *Fistulipora*. In the second place, we are unable to feel any certainty as to what the genus *Ceramopora*, Hall, really is supposed to include. The most recent definition of this genus is that given by Mr. E. O. Ulrich ("American Pal. Bryozoa," Journ. Cin. Soc. Nat. Hist. no. 3, vol. v. 1882), who defines the genus as including types with "angular" cells and oblique apertures, either with no "interstitial cells" or few, generally with "mural pores" and "occasionally" with tabulæ*. Now *F. incrustans*, Phill., does not possess "angular" corallites, always has numerous mesopores ("interstitial tubes"), unquestionably has no mural pores, and always possesses a larger or smaller number of tabulæ. It is therefore quite clear that *F. incrustans* cannot be placed under *Ceramopora*, Hall, as this genus is understood by Mr. Ulrich. It is also clear from Hall's figures and description of the type species of his genus *Ceramopora* (viz. *C. imbricata*, Hall), that, whatever may be the precise structure of this form, it has nothing in common with the coral here in question.

It need only be added that, supposing it had been shown that the young stages of *Fistulipora incrustans*, Phill., were identical in appearance with a presumed Polyzoan genus such

* The genus *Ceramopora*, as defined by Ulrich, can hardly be regarded as a natural group, seeing that it is said to comprise forms with or without "interstitial tubes," with or without mural pores ("connecting foramina"), with or without tabulæ ("diaphragms"). The only character as to which no option is given is that the apertures of the tubes are oblique, with an arched "lip." This character is, however, the principal one given in the diagnosis of the family Ceramoporidæ, Ulrich, and it cannot therefore be also used as a *generic* character of *Ceramopora*.

as *Ceramopora*, Hall, we should not for that reason adjudge the evidence as to its zoological position derived from its adult characters to be in any way invalidated. All that we should feel inclined to say would be that, in the case supposed, *Fistulipora incrustans* passed through a "Ceramoporoid stage" or a "Polyzoan stage," in precisely the same way that a Brachiopod may pass through an Annelidan stage in its development, and yet may not become an Annelid. As a matter of fact, however, we do not admit that *Fistulipora incrustans* was at any period of its growth a *Ceramopora*, or, indeed, in any way essentially different from what it became when fully matured. On the contrary, thin sections of the youngest specimens which we have been able to examine show an internal structure in all respects precisely similar to that exhibited by adult specimens. All that we can admit is that in its early condition of a very thin investing crust *Fistulipora incrustans* may have the general *aspect* of a Polyzoan; but here the resemblance ceases, and its intimate structure shows no indication of any alliance with the Polyzoa.

We think that from the evidence we have brought forward there is now good ground for assigning to the genus *Fistulipora*, M'Coy, a place among the Actinozoa, and probably in that division of it known as the Alcyonaria.

Formation and Locality. Fistulipora incrustans, Phill., is found in the Carboniferous Limestone, Bolland, Yorkshire (*Phillips*); Derbyshire and Ireland (*M'Coy*). Also in the Carboniferous rocks of Redesdale, Northumberland, where it is common, and in the west of Scotland (*John Young*).

Fistulipora muscosa, Nich. & Foord.
(Pl. XV. figs. 3, 3 *a*.)

Fistulipora minor, Nicholson, Pal. Tab. Corals, p. 306, fig. 39 (1879) [non *Fistulipora minor*, M'Coy].

Spec. char. Corallum forming thin irregular crusts, more or less extensively attached to foreign bodies. Autopores in the main oval, but commonly showing the trifoliate form characteristic of the genus. The autopores are rather less than half a millim. in diameter, about three of them occupying a space of 2 millim. (=about thirty-six in the space of an inch). The mesopores are angular and of variable size, two rows usually intervening between any given pair of autopores. The walls of the mesopores are very incompletely developed, and the close-set tabulæ coalesce to form a vesicular tissue.

The autopores have a few remote tabulæ, which in some tubes are seemingly altogether absent.

This species was originally described by one of us as *Fistulipora minor*, M'Coy (*loc. cit.*). In point of fact it is very closely allied to this species (*i. e.* to *F. incrustans*, Phill.), and differs from it only in certain minute characters. The principal points which distinguish *F. muscosa* from *F. incrustans* are the slightly smaller size of the autopores and their separation from one another to a proportionately greater distance than in the latter species, this last feature depending upon the more extensive development of the mesopores. Moreover the mesopores of *F. muscosa* are furnished with more imperfect walls than those of *F. incrustans*, while the autopores of the former are much more sparsely tabulate than is the case in the latter.

Formation and Locality. Rare in the Lower Carboniferous Limestone, Courland, near Edinburgh (*collected by Dr. Ramsay H. Traquair*).

Fistulipora crassa, Lonsdale, sp. (Pl. XV. fig. 1.)

Heteropora crassa, Lonsdale, Sil. Syst. pl. xv. figs. 14, 14 *a* (1839).
Fistulipora crassa, Nicholson, Ann. & Mag. Nat. Hist. ser. 5, vol. xiii. p. 118, pl. vii. figs. 1, 1 *a*, 2, 2 *a* (1884). [Non *Fistulipora crassa*, Rominger, Proc. Acad. Nat. Sci. Phil. p. 121 (1866).]

The fine specimen we have figured is from the collection of the late Mr. Johnson, of Dudley. The species has already been described and its microscopic structure illustrated by one of the writers in this journal (*loc. cit.*). The small dark spots upon the surface of the specimen represent the "maculæ." The name of Dr. Rominger's species (*loc. cit.*) must now be changed, and we propose for it that of *Fistulipora Romingeri*.

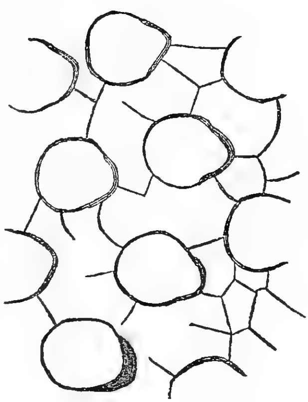
F. crassa is not uncommon in the Wenlock Shales at Dudley, and it is found also at Benthall Edge and at Dormington.

Fistulipora nummulina, Nich. & Foord. (Pl. XV. figs. 2–2 *c*.)

Spec. char. Corallum discoid, lenticular, concavo- or plano-convex, also forming thin, irregular, crust-like expansions; sometimes the corallum rises into a conical mass, with tapering margins, the central portion thus attaining a thickness greatly disproportionate to that of the margins. The surface is dotted over with numerous "monticules" (consisting of mesopores), which are slightly raised above the general level; they were doubtless more elevated originally, but have been reduced in height by the attrition which the whole of the corallum has

undergone. The autopores are sufficiently large to be distinctly seen with the naked eye; this arises in some measure from their infilling being of a lighter colour than that of the walls of the cells, otherwise they could hardly be perceived. They are oval or subcircular in form, the folds (which are plainly visible under a 1-inch objective) occupying about one fourth of the circumference of the walls and always pointing towards one of the centres of growth. About four of the autopores may be contained within the space of 1 millim.; a few of a somewhat larger size are grouped around the "monticules." Mesopores as seen in transverse section polygonal, very variable in size, sometimes equalling that of the autopores, sometimes much smaller. Longitudinal sections show that the autopores are provided with tabulæ, which are horizontal or a little curved, and that the mesopores are filled with closely-set tabulæ which have produced by their coalescence a vesicular tissue.

Fig 4.



F. nummulina, showing folds in the autopores.

Obs. The species to which *F. nummulina* is most closely allied is undoubtedly *F. crassa.* Externally the distinction between the two is very obvious, as appears on looking at the figures (Pl. XV. figs. 1, 2), one being of a discoid or flattened shape, and the other branching. In their microscopic characters also the two species are distinct enough; the autopores in *F. nummulina* being larger than those of *F. crassa*, only four of them being required to fill the space of a millimetre in the former species, while in the latter five must be taken.

Further, the tabulation of the mesopores is not nearly so dense in *F. nummulina* as it is in *F. crassa*, and its vesicular character is therefore not so strongly marked as it is in that species.

The present species is not unfrequently met with in the grey and greenish shales of the Wenlock group. The specimen figured was presented to one of the writers by Mr. W. Madeley, of Dudley, who has for many years collected the fossils of that region with much industry and discrimination. Other specimens referred to in drawing up the foregoing description are from the cabinet of Mr. C. Holcroft, also of Dudley.

Fistulipora utriculus, Rominger.
(Pl. XVI. figs. 1–1 *e*, & Pl. XVII. figs. 1, 1 *a*.)

Fistulipora utriculus, Rominger, Proc. Acad. Nat. Sci. Phil. p. 121 (1866) [no figures].

Corallum small, irregular, subramose, hollow, thin, subcylindrical or compressed; varying from $\frac{1}{2}$ millim. to 1 millim. or rather more in thickness. The surface is covered with monticules, which take the form of warty outgrowths, whose summits consist of clusters of mesopores. The latter may be seen with a strong hand-lens.

Under the microscope the surface of the corallum is observed to be minutely granulose (Pl. XVI. fig. 1 *b*), the granules being apparently the free ends or summits of the walls of the mesopores. The autopores can generally be seen without a lens; about four of them fill the space of 1 millim., and, as appears to be always the case, some of slightly larger size occur in the region of the "monticules" or areas of growth. The mesopores are of the usual angular form. The folds of the autopores are in this species remarkably well developed; they occupy from one third to one fourth of the circumference of the apertures; the latter are surrounded by a shallow depression, and their margins are slightly exsert. The outlines of the walls of the mesopores can be very distinctly made out in weathered specimens (Pl. XVII. fig. 1).

In tangential sections the autopores are seen to be of an irregular oval shape and of variable dimensions; the mesopores are sufficiently abundant to make three or four rows around the autopores. The areas of growth, as already stated, are found to be occupied entirely by the mesopores, and around them the autopores are ranked in three or four concentric rows (Pl. XVI. fig. 1 *c*). Longitudinal sections show that the autopores have but few tabulæ, while those of the mesopores are abundant and are of the usual vesicular description.

Obs. We give some additional figures of this very characteristic and interesting species. Fig. 1, Pl. XVII., is a microscopic view of the slightly weathered surface. It is drawn on the same scale as fig. 1 *b*, Pl. XVI. * (enlarged about forty times), and shows the walls of the mesopores; the interior of these cells, as well as that of the autopores, being filled with crystalline calcite. Fig. 1 *a*, Pl. XVII., is intended to illustrate the projection of the autopores above the general surface of the corallum and the prominence of the arched lips (folds).

Dr. Rominger (*loc. cit.*) has compared this species with two

* In this figure the walls of the mesopores are not indicated, because they are not visible in this part of the specimen, owing, it would seem, to their uniformity of colour with the rest of the surface.

others described by him, viz. *F. eriensis* and *F. spinulifera.* We cannot corroborate the accuracy of his comparison with reference to the latter of these forms, for we do not possess specimens of it; but with regard to *F. eriensis* we find ourselves quite unable to agree with Dr. Rominger. It is in every way a coarser form than *F. utriculus*; it occurs in large laminate folded masses, and the autopores greatly exceed in magnitude those of *F. utriculus.* *F. eriensis*, moreover, is provided with acanthopores, which are wanting in *F. utriculus.*

The present species resembles *Fistulipora trifoliata*, Schlüt. (Pl. XVIII. figs. 1–1 *c*), in the strong development of the folds of the autopores, but in other details of its structure as well as in its habit of growth it is sharply distinct from that form. There is another species, however, to which *Fistulipora utriculus* is very closely related, viz. *F. Goldfussi*; and it was not without hesitation that we resolved to keep them apart. Both are exactly similar in habit of growth and external markings, and there is also a general conformity in their minute structure. The points in which the two species are dissimilar are these: the autopores are larger and less numerous in *F. utriculus* than they are in *F. Goldfussi*, and the folds are more strongly developed in the former species than they are in the latter.

Formation and Locality. Common in the shales of the Hamilton group (Devonian), at Thetford (formerly called Widder), and at Arkona, in the Province of Ontario, Canada.

Fistulipora Torrubiæ, De Verneuil & Haime, sp.
(Pl. XVI. figs. 2, 2 *a*, 2 *b*.)

Chætetes Torrubiæ, De Verneuil & J. Haime, Bull. Soc. Géol. de France, 2e sér. t. vii. p. 162 (1850) [no description or figures]; Milne-Edwards & Haime, Polyp. Foss. des Terr. Pal. p. 268, pl. xx. figs. 5, 5 *a* (1851).

Monticulipora Torrubiæ, Milne-Edwards, Hist. Nat. des Coralliaires, tom. iii. p. 277 (1860).

Spec. char. Corallum subramose, or in large sublobate masses, which present a coarsely mamillated appearance and are made up of a succession of concentric superimposed laminæ. Surface monticulose; the monticules rather inconspicuous, distant from each other 3 or 4 millim. Autopores subcircular or oval in general outline, closely approximated; rarely in contact; readily distinguishable by the naked eye. About three of those of average size occupy the space of 1 millim., and about two of the larger ones, which are in the region of the "monticules," fill a similar space. The folds of

the autopores may be seen on well-preserved surfaces under the microscope; they are small, occupying not more than about one sixth of the circumference of the walls. A few autopores have been drawn on an enlarged scale (Pl. XVI. fig. 2 *a*) to show the folds. The latter become very obscure in sections cut below the surface layers of the corallum, and they were overlooked in the larger section (fig. 2). The autopores, as shown in longitudinal sections (fig. 2 *b*), are crossed by tabulæ, which are comparatively numerous, and are separated from each other by variable spaces, measuring roughly from one to two tube diameters. The mesopores are in this species remarkably few in number, so that it frequently happens that only a single row of them is interposed between two of the autopores. The tabulæ in the mesopores are unusually wide apart, and sometimes occur at the same level in contiguous tubes, which appear at first sight to be separated by distinct walls. In other parts of the corallum, however, the characteristic vesicular tabulæ are met with.

Obs. This species was first described and figured in the 'Polypiers Fossiles des Terrains Paléozoïques' (*loc. cit.*). The first notice of it, however, appeared in a list of Devonian fossils from the district of Sabero (Léon) by M. de Verneuil (*loc. cit.*). The description of *Fistulipora Torrubiæ* by the authors of the 'Polypiers Fossiles' refers only to its external characters.

The species to which this is most nearly allied is *Fistulipora incrassata*, Nich. (Pal. Tab. Corals, p. 308, pl. xv. figs. 3–3 *b*, 1879), from the Hamilton group (Devonian) of Canada. The corallites in that species are, however, somewhat larger than those of *F. Torrubiæ*, the mesopores less numerous, and the folds of the autopores more strongly developed.

Formation and Locality. F. Torrubiæ is somewhat widely distributed geographically, and is reported to have been found in Devonian rocks at the following localities:—Asturias (Spain), Eifel (Westphalia), Boulonnais &c. (France).

Fistulipora Goldfussi, Michelin, sp.
(Pl. XVII. figs. 2, 2 *a*, 2 *b*.)

Ceriopora Goldfussi, Michelin, Iconogr. Zoophyt. p. 190, pl. xlviii. fig. 9 (1847).

?*Chætetes Goldfussi*, Quenstedt, Petref. Deutschl. Abtheil. i. p. 83, t. cxlvi. figs. 28, 29 (1878).

Corallum ramose, hollow, subcylindrical. Surface uneven, irregularly dilated here and there. "Maculæ" not very conspicuous. Corallites very minute; about seven of the autopores

may be contained within the space of 1 millim. The folds occupy from one fourth to one fifth of the circumference of the autopores.

Obs. The relationship between *Fistulipora utriculus* and this species has already been pointed out.

We are indebted to Dr. Henry Woodward, F.R.S., for his kindness in permitting us the use of specimens contained in the collections of the British Museum (Nat. Hist.) in preparing the foregoing description.

Fistulipora dobunica *, Nich. & Foord.
(Pl. XVII. figs. 3, 3 *a*, 3 *b*.)

Corallum extremely thin, incrusting; attaching itself to various foreign bodies, whose surface contour it follows in all its irregularities; occasionally, however, putting forth short hollow cylindrical prolongations, generally at right angles to the surface (fig. 3). Surface dotted with maculæ. The corallites, though very minute, can usually be seen by the naked eye. About six of the autopores are contained within the space of 1 millim.; others, of a little larger size, occur in the vicinity of the maculæ. The folds in the autopores are well developed and occupy nearly one third of the circumference of the walls of those corallites (fig. 3 *a*). There is nothing remarkable in the microscopic structure as seen in longitudinal sections.

Obs. As might be supposed, some difficulty was experienced in obtaining satisfactory sections from such an extremely thin corallum.

Some of the autopores have been shaded, the better to distinguish them from the mesopores.

We are unacquainted with any species with which to compare *F. dobunica.* The extreme tenuity of its corallum and its incrusting habit resulting from this, together with the minuteness of its corallites, are the distinguishing marks of this species. The specimen figured is from the collection of Mr. Madeley, of Dudley.

Formation and Locality. F. dobunica appears to be tolerably plentiful in the Wenlock Shales (Upper Silurian) at Dudley.

Fistulipora eriensis, Rominger. (Pl. XVII. figs. 4, 4 *a*.)

Fistulipora eriensis, Rominger, Proc. Acad. Nat. Sci. Phil. p. 121 (1866).

Corallum in large, irregular, laminated and folded masses;

* The Dobunii were a tribe of ancient Britons, neighbours of the Silures.

growing in concentric layers measuring as much as 8 centim. in breadth and 2 centim. in thickness. Surface monticulose; the monticules conspicuous, from 2 to 3 millim. apart, consisting of mesopores. Autopores comparatively large, readily distinguishable by the naked eye. About three of them fill the space of 1 millim. The folds are of average size and occupy about one fourth of the circumference of the walls of the autopores. Acanthopores may be seen in transverse sections at the angles of the walls of the mesopores. Longitudinal sections show considerable regularity in the disposition of the vesicular tabulæ in the mesopores. The autopores have very few tabulæ.

Obs. The presence of acanthopores distinguishes *Fistulipora eriensis* from all other species of the genus with the exception of *F. ludensis*, Nich. (this journal, p. 119, Feb. 1884), from which it is completely separated by its habit of growth and the much larger dimensions of its corallites. The occurrence of acanthopores is in fact the only feature which these two species possess in common. The expression "spinuloso-granulose," employed by Dr. Rominger in reference to the surface of this species, no doubt refers to the acanthopores, which may be visible externally on well-preserved specimens. We have only detected them in transverse sections.

Formation and Locality. Hamilton Group (Devonian), Canandaigua, Ontario Co., New York.

Fistulipora eifeliensis, Schlüter, sp.

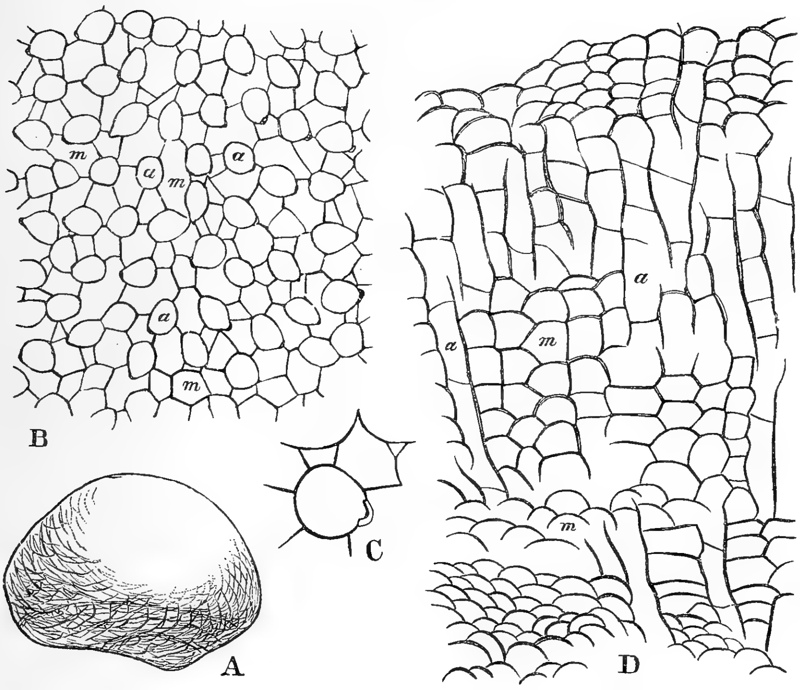
Callopora eifeliensis, Schlüt. Sitzungsberichte der niederrheinischen Gesellschaft in Bonn (Physikalische Section), p. 72, Feb. 14, 1881.

Corallum hemispherical, with a slightly conical base, which may have been furnished with an epitheca. The surface is provided with slightly raised "monticules," upon which there are clusters of the mesopores. In weathered specimens the corallites may be very distinctly made out; they measure about $1\frac{1}{2}$ millim. in their longer diameter by about 1 millim. in their shorter. The autopores are irregularly oval or subcircular in outline, and are in general completely isolated from each other by the mesopores, but occasionally two come into contact either at their sides or at their extremities. The folds are very small in this species, as may be seen in the section, fig. B. The mesopores vary greatly both in size and in shape; in some instances four of them encircle an autopore, in others six.

Longitudinal sections show that the autopores are divided

by a few remote tabulæ, while the mesopores exhibit the characteristic vesicular tabulation of the genus, especially near the base of the colony. As growth proceeds this tabulation assumes a more regular appearance, and may consist of two or more rows of cells as it were dovetailed into each other (fig. 5, D).

Fig. 5.



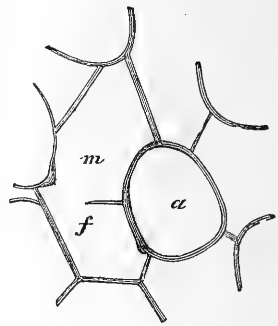
Fistulipora eifeliensis, Schlüt. sp. A. Corallum, natural size; the shading is given merely to show the rotundity of the specimen and the somewhat conical base. B. Transverse section, enlarged about twelve times. C. One of the autopores, showing the fold, enlarged about twenty times. D. Longitudinal section, enlarged about twelve times. *a*, autopores; *m*, mesopores.

Obs. An interesting feature is noticeable in the mesopores of this species. Certain of them, larger than the average and of a subelliptical form, are partially divided by a projection as thick as the cell-walls, which extends from those walls about halfway across the cell-cavity (woodcut, fig. 6).

These projections appear to indicate very clearly a fissiparous mode of growth in such cells.

In drawing attention to the substitution of the generic name *Fistulipora* for that of *Callopora*, to which latter genus Prof. Schlüter assigned the present species, we have only to observe that there exists a well-marked distinction between the two genera, which may be briefly stated as follows:—In *Fistulipora*, as has been shown above, the mesopores are crossed by imperfect tabulæ, which, coalescing, form a vesicular tissue; in *Callopora*, on the other hand, the tabulation of the mesopores is not essentially different from that of the autopores, except that the tabulæ are much more numerous in the former cells than they are in the latter. The mesopores in *Callopora* are further, as a rule, bounded by perfect walls. It is scarcely necessary to point out that the structure of the present form accords with that of *Fistulipora* and not with that of *Callopora*.

Fig. 6.



a, autopore; *m*, mesopore; *f*, fission.

Fistulipora eifeliensis stands alone in the remarkably large size of its corallites, which exceed in their dimensions those of any other species of *Fistulipora* with which we are acquainted.

Formation and Locality. Not uncommon in the Middle Devonian of Gees, near Gerolstein, Eifel.

Fistulipora trifoliata, Schlüter. (Pl. XVIII. figs. 1–1 *c*.)

Fistulipora trifoliata, Schlüt. Sitzungsberichte der niederrheinischen Gesellschaft in Bonn (Naturwissenschaftliche Section), p. 147, May 11, 1885.

Corallum hemispherical, growing on the shells of mollusks and other foreign objects. Surface not well preserved in any of the specimens examined, apparently smooth. Corallites extremely minute, barely distinguishable by the naked eye. "Maculæ" distant from each other from 3 to 4 millim. About six of the autopores fill the space of 1 millim., while some of a larger size invest the "maculæ." On looking at a tangential section (figs. 1 *a*, 1 *b*) it is found that the autopores have their outline interrupted by the very strong folds in their walls, which impart a distinctly trifoliate aspect to them. The free edges of the folds sometimes extend far into the lumen

of the cells. The mesopores are sufficiently numerous to completely isolate the autopores from each other; they exhibit the usual polygonal form. A few, of a comparatively large size, occupy the central portions of the "maculæ," and towards these the folds of the autopores are directed. Longitudinal sections show the finely vesicular character of the tabulæ in the mesopores and the growth of the corallum in concentric layers. These sections also show that the autopores diverge in a flabellate manner from their centres of growth. A like feature is also noticeable in *F. cornavica* (Pl. XVIII. fig. 2 *c*).

Obs. The present form has been well known to us for more than a year, but we have not till now been in a position to publish a description of it. In the meantime Professor Schlüter, of Bonn, has been before us in the matter. As, however, that author has given neither figures nor measurements of his species, we have felt ourselves justified in redescribing it and supplying those deficiencies, more especially as it exhibits in a marked degree one of the most characteristic features of the genus, viz. those remarkable folds in the walls of the autopores.

In its general structural features this species resembles *F. cornavica*, Nich. & Foord (*infrà*). The two species are figured upon the same Plate (XVIII.) to facilitate comparison. It will be seen that the corallites of *F. cornavica* are larger than those of *F. trifoliata*, and also that the autopores in the latter are more highly developed than they are in the former.

We are indebted to Prof. Schlüter for sections of *F. trifoliata*, which place beyond question the specific identity of his species with ours, a point which we were unable to decide from his description alone.

Formation and Locality. Somewhat rare in the Middle Devonian of Gees, near Gerolstein, Eifel.

Fistulipora cornavica *, Nich & Foord.
(Pl. XVIII. figs. 2–2 *c*.)

Corallum subhemispherical, attached by its base to shells or other marine objects; composed of a succession of thin concentric layers, which apparently mark periodical cessations of growth. Surface monticulose, the "monticules" consisting of mesopores. Autopores, as seen in transverse sections, irregularly ovate, the folds occupying about one fourth of the circumference of their walls. About four of the autopores fill the space of 1 millim. Mesopores nume-

* The Cornavii were a tribe of ancient Britons who, along with the Ordovices, inhabited Shropshire at the time of the Roman invasion.

rous and mostly of large size. Longitudinal sections show that the tabulæ by which the cavities of the autopores are crossed are placed at irregular distances apart. The divergence of the autopores from their centres of growth may also be observed in these sections (fig. 2 *c*).

Obs. A comparison has already been made between this form and *F. trifoliata* in treating of the latter.

Formation and Locality. Appears to be rare in the Wenlock Shales (Upper Silurian) at Buildwas, Shropshire.

NOTE.—In his Hist. Nat. des Coralliaires (vol. i. p. 67, 1860) M. Milne-Edwards gives a highly suggestive explanation of what he conceives to have been the origin of vesicular tabulæ. We beg permission to lay before the reader the following translation of it:—

"According to the known disposition of the soft parts of the polyps it is evident that the tabulæ should correspond to the spaces left open by the atrophy or the successive retreating of the inferior extremities of the mesenteric folds [*lames*], and the degree of their separation would depend upon the length to which this retreating or atrophy was carried in proportion to the growth of the animal. If this upward movement [of the animal] was effected rapidly and completely in each cell [*loge*] it would result in the tabulæ being simple and apart from each other. But if the movement was made little by little in an incomplete and limited manner in the different parts of the cells there would be formed a series of blisters or vesicles, of which the general appearance would be that of a cellular or vesicular tissue."

EXPLANATION OF THE PLATES.

PLATE XV.

Fig. 1. *Fistulipora crassa,* Lonsd. sp. View of corallum in the matrix, nat. size. (Coll. Johnson, Dudley.)

Fig. 2. *Fistulipora nummulina,* Nich. & Foord. View of upper surface of corallum, nat. size.

Fig. 2 *a.* Side view of the same specimen, to show thickness of corallum.

Fig. 2 *b.* Transverse section, enlarged about twenty times.

Fig. 2 *c.* Longitudinal section, similarly enlarged.

Fig. 3. *Fistulipora muscosa,* Nich. & Foord. Transverse section, enlarged about twenty times.

Fig. 3 *a.* Longitudinal section, enlarged to the same extent.

PLATE XVI.

Figs. 1, 1 *a.* *Fistulipora utriculus,* Rom. Two examples of the corallum of this species, nat. size.

Fig. 1 *b.* Surface, showing arched lips (folds) at the apertures of the autopores, enlarged about forty times.
Fig. 1 *c.* Transverse section, showing one of the "maculæ," with the autopores ranged around it; enlarged about twenty times.
Fig. 1 *d.* A portion of the same section, enlarged about forty times.
Fig. 1 *e.* Longitudinal section, enlarged about twenty times.
Fig. 2. *Fistulipora Torrubiæ*, De Vern. & Haime. Transverse section, enlarged about twenty times.
Fig. 2 *a.* Portion of another section, to show folds in the autopores, enlarged about forty times.
Fig. 2 *b.* Longitudinal section, enlarged about forty times.

PLATE XVII.

Fig. 1. *Fistulipora utriculus*, Rom. Surface partially weathered, showing autopores and mesopores, enlarged about forty times.
Fig. 1 *a.* Surface of the same, viewed in profile, showing prominence of the arched lips of the autopores. Similarly enlarged.
Fig. 2. *Fistulipora Goldfussi*, Mich. Corallum of the natural size.
Fig. 2 *a.* Transverse section, enlarged about twenty times.
Fig. 2 *b.* Longitudinal section, enlarged to the same extent.
Fig. 3. *Fustulipora dobunica*, Nich. & Foord. View of the corallum of the natural size.
Fig. 3 *a.* Transverse section, enlarged about twenty times.
Fig. 3 *b.* Longitudinal section, similarly enlarged.
Fig. 4. *Fistulipora eriensis*, Rom. Transverse section, enlarged about twenty times.
Fig. 4 *a.* Longitudinal section, similarly enlarged.

PLATE XVIII.

Fig. 1. *Fistulipora trifoliata*, Schlüt. View of the corallum of the natural size.
Fig. 1 *a.* Transverse section of one of the "maculæ," enlarged about twenty times.
Fig. 1 *b.* Transverse section, enlarged about forty times.
Fig. 1 *c.* Longitudinal section, enlarged about twenty times.
Fig. 2. *Fistulipora cornavica*, Nich. & Foord. View of the corallum, growing on a Brachiopod shell. Nat. size.
Fig. 2 *a.* Transverse section, enlarged about twenty times.
Fig. 2 *b.* One of the autopores, enlarged about forty times.
Fig. 2 *c.* Longitudinal section, enlarged about twenty times.

BIBLIOGRAPHICAL NOTICE.

Contributions to the Knowledge of the Older Mesozoic Flora of Virginia. By WILLIAM MORRIS FONTAINE. *Monographs of the United States Geological Survey.* Vol. VI. Pp. 144, with 54 plates. Washington: 1883.

THE present volume contains a very full account of the older Mesozoic flora of Virginia. The author introduces the subject by a short geological sketch of the area from which the fossil plants were collected, in which is pointed out that the Mesozoic strata of Virginia are divisible into two well-marked groups, an older and a younger, both of which are characterized by plants of a totally different aspect. It is only those from the older Mesozoic group, however, with which the present monograph deals.

By far the greater portion of the specimens described in the work were derived from the area in the neighbourhood of Richmond which Mr. Fontaine distinguishes as the "Richmond Coal-field," as it is the most important district and contains nearly all the workable coal in the Mesozoic strata of Virginia. Considerable difficulty has been experienced in collecting specimens, as few openings have been made in the strata for many years; hence the specimens had in great measure to be collected from old and weathered refuse-heaps. Thus the work of securing good examples has been one of great labour.

As typical of the older Mesozoic areas of Virginia and as the most completely explored, the geology of the Richmond Coal-field is more fully described than that of any of the other areas. It contains several valuable coal-seams, but their number and thickness vary much in different parts of the field. There are, however, two important seams which appear to be persistent; of these the lower, called the main or big seam, is the most valuable, and though varying greatly in thickness and often dividing into two seams, attains at Clover Hill a varying thickness of from 15 to 26 feet.

The second part of the work comprises the description of the fossil plants, in which two new genera are created and many new species described. One of the new genera is named *Mertensides*, from the similarity of the individuals it embraces to the *Mertensia* group of the Gleicheniaceæ; but the ferns it includes differ in not showing the characteristic dichotomy of the *Mertensia*. The type of this genus is *Mertensides* (*Pecopteris*) *bullatus*, Bunbury, sp. The other new genus is *Pseudodanæopsis*, containing ferns with a Dictyopteroid nervation, but which also in some of their characters approach to Heer's *Danæopsis*. It contains two species, *Pseudodanæopsis reticulata* and *P. nervosa*.

Among the new species, *Lonchopteris virginiensis* is of special interest. The genus *Lonchopteris* was formerly regarded as Palæozoic, and only known to occur in the Coal-measures; but in *Lonchopteris virginiensis* there is one of the most handsome species of the genus, which is now shown to extend upwards to the Rhætic. In all forty-two species of plants are described from the older Mesozoic rocks of Virginia; of these, twenty-one are peculiar to the locality, four are either found in the Trias or allied to Triassic forms, eight are similar to plants found in the Jurassic or allied to plants occurring in rocks of that age, and twelve are either found in the Rhætic or allied to plants of that formation.

The third part of the work is devoted to the older Mesozoic flora of North Carolina, with the object of instituting a comparison between its fossil flora and that occurring in the Virginian Mesozoic area. Many of Emmons's species from North Carolina were, however, inaccurately determined; hence it was necessary for Mr. Fontaine to enter into a critical examination of Emmons's species, and as far as possible to correct his determinations. In the treatment of this difficult part of his subject Mr. Fontaine has acted most fairly, for he gives in Emmons's own words the descriptions of that writer's

species, accompanying them with a reproduction of the original figures; on these plants Mr. Fontaine makes many notes and corrections.

With the list of North-Carolina plants thus corrected a comparison is made with those from Virginia, which shows that both areas are of the same age.

A further comparison of the fossil plants from North Carolina and Virginia is instituted with those from Indian and European Mesozoic rocks, when the author arrives at the conclusion that the Mesozoic floras of North Carolina and Virginia are most probably Rhætic in age, certainly not older; he is also inclined to regard the Rhætic as forming transition beds, having more affinity with the Lower Lias than with Triassic strata.

The whole work evinces very careful investigation; the descriptions are full and the value of the monograph is greatly enhanced by the numerous figures which accompany the descriptions. The book cannot fail to prove of the greatest value to those interested in fossil botany. The author has contributed a valuable addition to the ever-increasing monographs of the United-States Geological Survey.

MISCELLANEOUS.

Instinct of Orientation in Helix aspersa. By F. d'A. Furtado.

In a house which I inhabited at St. Michael's, one of the Azores, there was a veranda with a flight of steps leading to a little court or garden. Above this was a second veranda supported by a stone column, which rested on the wall of the lower veranda. At the foot of the column had been set a flower-pot with a young banana bearing two or three leaves.

One morning I noticed a snail (*Helix aspersa*) lodged between the pot and the column, as if waiting for night to attack the plant. A leaf had already been gnawed, and to stop further depredations I threw the snail into the court. It was not much the worse for the fall, as it chanced to light upon a small manure-heap.

Next morning I was surprised to find the snail in precisely the same position as before between the pot and the column. I knew it by its size and colour, as well as by a curious covering of spiders' webs which it bore. It was evident that the snail possessed a remarkable sense of direction, which enabled it, after a violent shock, to make its way back over a distance of at least 6 metres in a very short time. In order to get to the bottom of the matter I threw the snail back to the heap and watched the result, which was as follows:—

June 10, 1884.—At about 9 A.M. the snail was resting, completely retracted within its shell, on the rail of the staircase, having travelled nearly 4 metres. In the evening it resumed its march, but so slowly that by 10 o'clock it had only reached the top of the rail, where it stopped again, having traversed a metre in two hours.

Twenty minutes after midnight it began to travel along the balustrade of the veranda, taking at first a very undecided course, but as soon as it reached the edge of the balustrade making straight for the banana. Halfway it was turned aside by some fish-scales, which no doubt indicated that the surface was contaminated; but it soon regained its previous direction. Near the column it fell in with a grooved washing-board, which it seemed to remember, for it reared its head and tentacles towards it while still 2 centimetres off. So far 2 metres had been traversed in twenty minutes. The snail now advanced resolutely from the board to the flower-pot as if over known ground. (The board had lain in the same place for several days.) I watched its movements by a lamp set far off so as to give only a faint light; but when it reached the pot the animal became shaded by weeds which grew there, and I found it necessary to bring the lamp near, in order to observe the movements of the snail's lips and tentacles. It climbed the pot rapidly, mending its pace as it got nearer, then it examined the rim with care, and at last crawled over the mould. For a quarter of an hour it wandered among the weeds in the pot, licking them frequently. When I saw it explore the soil with its lips and larger tentacles, while the reproductive orifice seemed to open from time to time, I thought that it was seeking a convenient spot to lay its eggs. At last it came up to the banana, mounted it, and began to gnaw the leaf previously attacked exactly where it had left off before. I was standing a little way off to avoid disturbing the snail, but could readily detect the peculiar odour of the gnawed leaf. Very likely the snail could perceive, even in an uninjured leaf, that scent which only became apparent to me when the leaf was bruised or cut, and this may have helped to guide its course. Scent alone will not, however, explain all the movements of the animal. At 2 P.M. I left it feeding.

June 11.—At 10 A.M. very little of the leaf had been devoured. The snail was comfortably established, as before, between the column and the pot.

After this the snail wandered over a vine which trailed about the column and upper veranda. Finding that it was disposed to escape to the next garden, I opened it on June 17 to see whether it was ready to lay eggs. There was not a single egg in the oviduct, and a large dart in the dart-sac proved that no sexual congress had lately taken place.

These observations seem to show that a land-snail may possess an instinct which enables it to choose its abode and return to it at pleasure. We have here the same love of home and topographical knowledge which have been observed, and noted with wonder, in the limpet (George Roberts, in Woodward's 'Manual of Mollusca,' p. 11).—*Zoological Section of the Lisbon Museum*, Oct. 27, 1885.

On the Existence of a Postoral Band of Cilia in Gasteropod Veligers. By J. Playfair M'Murrich.

The question as to the phylogeny of the Mollusca is as yet undecided, though recent researches indicate a relationship between this group and that of the Annelida. The discovery of the peculiar

forms *Neomenia*, *Proneomenia*, and *Chætoderma* gave a strong impulse to this idea on account of their similarity in some respects to what obtains in the Polyplacophora; but it is not safe to argue a direct descent from these forms, or even to imagine that they come into the ancestral line at all. It is quite possible that they and the Polyplacophora are offshoots from the direct stem, and probably we must look more to the embryological history of the Gasteropods for light on the subject. Attempts have been made, notably by Hatschek (' Studien ü. Entwickelungsgesch. d. Anneliden,' Wien, 1878), to trace a relationship between the *Polygordius*-larva of the Annelida and the Molluscan larva, and thus to throw any relationship which may exist between the two groups back to a very early period in their evolution.

If it can be shown that there is considerable similarity between the larvæ of the two groups, and if the differences which do exist can be explained as adaptations to new conditions, the presumption as to the genetic relations between the larvæ will be greatly strengthened. As regards the arrangement of the cilia, which is the only point to be dealt with in this note, we have in the *Polygordius*-larva a strong præoral locomotive band, a more delicate postoral nutritive band, and a still less apparent ciliated region lying between these two bands and leading into the ciliated mouth. The identity of the cilia of the velum of the Gasteropod larva with the first of these has been frequently noticed; they form a strong præoral band, occasionally double, and differing from the band of the *Polygordius*-larva only in the extent of its development, and in its incomplete closure in many cases dorsally. This latter point of difference does not, however, hold throughout; the former may be explained by the necessity for a more powerful locomotive apparatus than is required for the Annelida, caused by the presence of a shell, a structure which appears very early in the life-history of the Mollusca. A postoral band has never as yet been described for the Prosobranchs. Several observers have called attention to the presence of a single band of cilia behind the cilia of the velum, and have regarded it as nutritive in function, and the object of this note is to call attention to the fact that this band passes across the ventral surface of the larva behind the mouth, and is therefore quite comparable to the postoral band of the Trochophore. My attention was first called to this fact in the larvæ of *Crepidula fornicata*, and I was afterwards able to confirm it in those of *Fulgar carica*, in a species of *Neptunea*, in two Prosobranch Veligers as yet undetermined, and in the Opisthobranch *Montaguia*, sp.? In the undetermined Veligers the velum was produced into four long flattened arms, round the margins of which were the strong locomotor cilia. On the under surface of the arms, running parallel to and not very remote from the locomotor cilia, was the finer band of nutritive cilia, the transparency of the arms and their size rendering it very apparent, and it could without much difficulty be traced across the ventral surface of the body immediately behind the mouth. Dr. W. K. Brooks informs me that he noticed the existence of this postoral band some time ago, and was then inclined to attribute some phylo-

genetic importance to it; but being occupied with other investigations he did not follow up his observations, and refrained from publication. Haddon also has described and figured it for certain Opisthobranchs, but does not seem to have observed it in the Prosobranchs he studied.

The region between these two bands is occupied by numerous very fine cilia, which, as in the *Polygordius*-larva, are continuous with those lining the mouth-opening and the œsophagus. The arrangement of cilia which is to be found in the typical Annelid larva is therefore almost exactly reproduced in the Gasteropod Veliger.

Arguing from ontogeny, a phylogenetic history of the Gasteropods somewhat as follows may be constructed. They and the Annelida have had their origin in a Trochophore. In the Gasteropods this ancestor developed a univalve shell, represented by the larval shell so often replaced as development proceeds by another more ornamented and more complicated in structure. The development of this shell, by increasing the specific gravity of the animal, rendered the simple præoral cilia of the Trochophore insufficient for active locomotion, and the extent of the band was increased by the region of the body on which it occurred being as it were pulled out laterally, the characteristic velum being thus produced. Perhaps, too, in the presence of the shell, a reason can be found for the absence of metameric segmentation in the Gasteropods.—*Johns Hopkins University Circulars*, Oct. 1885, p. 5.

Results of a Faunistic Excursion in the Iser-, Riesen-, and Glatzer Gebirge. By Dr. Otto Zacharias.

With the aid of subventions from the Berlin Academy and the Silesian Society the author has made a second excursion in the region of the Iser-, Riesen-, and Glatzer Gebirge, and obtained some interesting results, especially in relation to the Turbellaria. He has ascertained positively that, as indicated more than fifty years ago by Draparnaud, Dalyell, and Dugès, at certain times reproduction by spontaneous transverse division takes place in many freshwater Planarians. In the Iser Gebirge he has found a *Polycelis cornuta*, apparently identical with that described by O. Schmidt (Zeitschr. wiss. Zool. x. 1860, pp. 25, 26), which propagates exclusively by transverse division. In a brook near Hirschberg he obtained *Planaria tentaculata*, Drap. (already observed by Dugès), which for weeks together reproduced by simple division, or rather by terminal gemmation. In this *Planaria* he ascertained by serial sections that there was not the smallest trace of either male or female sexual organs. He states, however, that during the autumn individuals occasionally appeared in which distinctly differentiated sexual organs were recognizable.

Dr. Zacharias has also investigated the minute anatomy of the Turbellaria, especially with respect to the exact course of the two lateral nerves and the innervation of the pharynx. His investigations were made upon a new species described by him under the name of *Monotus relictus* (Zeitschr. wiss. Zool. xli. 1885, p. 505). In this species he succeeded in ascertaining the whole course of the lateral nerves (from the cerebral ganglion to the posterior extremity

of the body), and in obtaining sections which plainly showed the penetration of offshoots of the lateral nerves into the pharynx. His most important point is the demonstration of the existence in the connective layer of the pharynx of a large annular ganglion, which exceeds the true cerebral ganglion in size, and this explains the extraordinary mobility and vitality of the pharynx, which almost seems to be an independent creature.

The author further investigated the Cladocera and Copepoda of the district, and also its Hydrachnidæ; among the latter he notices his discovery of a new species of the genus *Sperchon*, Kramer, and of a new *Arrenurus*. He also obtained two new Rotatoria and an undescribed Turbellarian (belonging to the genus *Prorhynchus*).—*Zoologischer Anzeiger*, no. 206, p. 575.

Note on the Blastodermic Vesicle of Mammals. By Prof. A. C. Haddon, M.A., M.R.I.A.

The author suggests the view that in the blastodermic vesicle of mammals at the close of segmentation the inner mass, since it gives rise to the embryo proper, is perfectly comparable with the germinal disk of a fowl during the later stages of segmentation, which has sunk into the blastodermic vesicle owing to the absence of yolk. The outer layer corresponds to those epiblast-cells which are gradually enclosing the yolk, the so-called blastopore of Van Beneden indicating in an exaggerated manner the distinction between the embryonic and non-embryonic germinal layers. Epiblast-cells grow over this "blastopore" and form the covering cells (Deckenzellen); eventually the invagination of the germinal area is rectified, and there is a diploblastic ovum, the covering cells forming the spurious third layer which misled Van Beneden. The segmentation of the ovum is next discussed, and the conclusion is arrived at that the first immigration of blastospheres into the interior of the ovum (Van Beneden's stage 3) indicates the gastrula stage. It would further appear that this immigration was asymmetrical, much as there is an asymmetrical invagination of the hypoblast in telolecithal ova. The extension of cells of the blastodermic vesicle over the embryonic area is probably to be accounted for, in most cases, by the sinking of the latter into the cavity of the former. These "Deckenzellen" are really a portion of the blastodermic vesicle, that is of the yolk-sac, and they form the first adhesion between the ovum and the parent. This is compared with the imperfect attachment of the embryos of marsupials to the uterine wall, which is effected solely by the yolk-sac, as has been recently demonstrated by H. F. Osborn and by Caldwell.—*Proc. Roy. Dublin Soc.* n. s. iv. pp. 536–547.

Note on Halcampa chrysanthellum, *Peach.* By Prof. A. C. Haddon, M.A., M.R.I.A.

In a paper read before the Royal Dublin Society on November 18, 1885, Professor A. C. Haddon withdrew the name applied by him to a species of *Halcampa* from Malahide, co. Dublin (Proc. R. Dubl. Soc. n. s. iv. p. 396, pl. xvi.). After having examined a number of specimens it was found that this species is an extremely variable one; its synonyms are:—*H.* (*Xanthiopus*) *vittata*, Kef.; *H.* (*X.*) *bilateralis*, Kef.; *H. Keferstein*i, Andr.; *H. Andresii*, Hadd. A full description and figure were given.

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END OF THE SIXTEENTH VOLUME.

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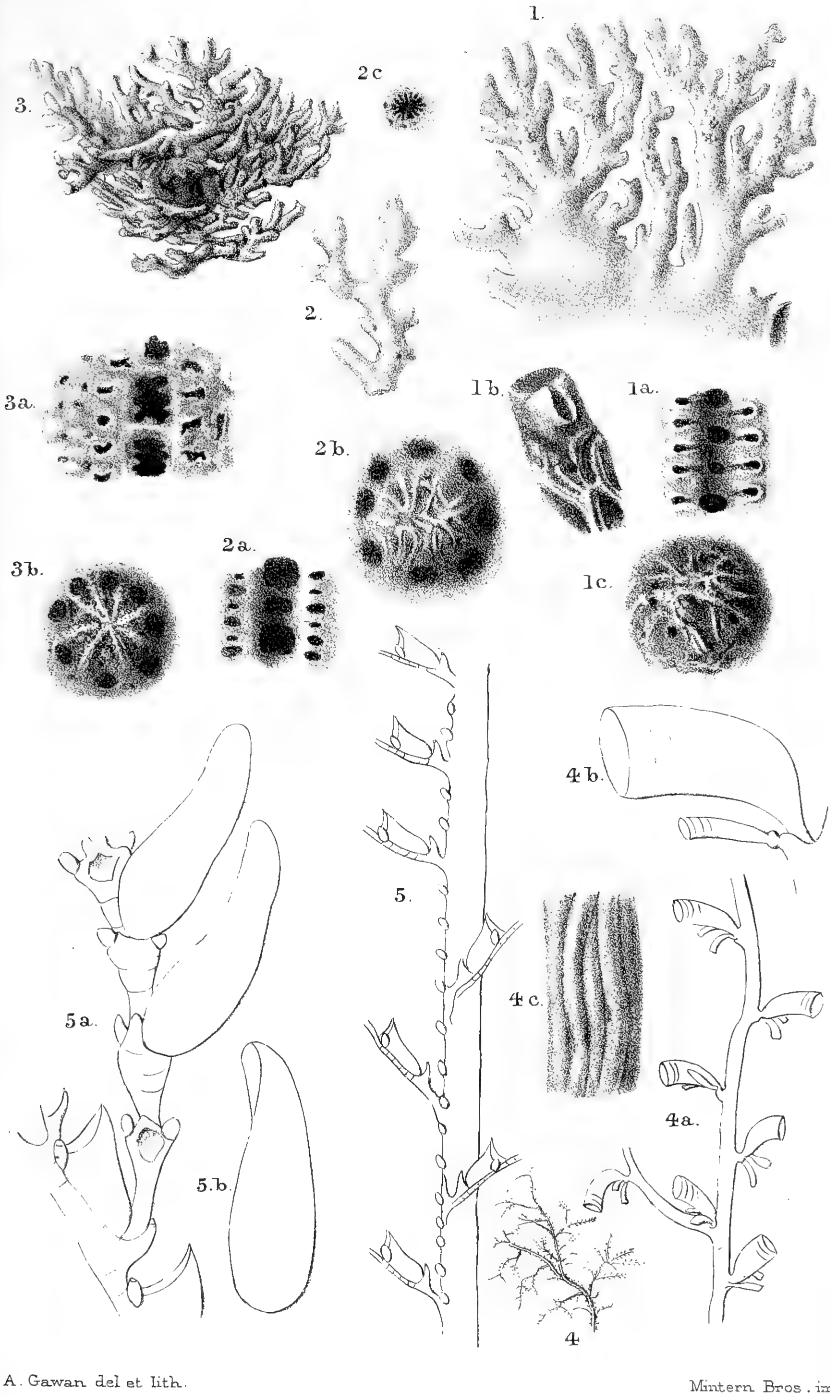
WITH SEVEN PLATES.



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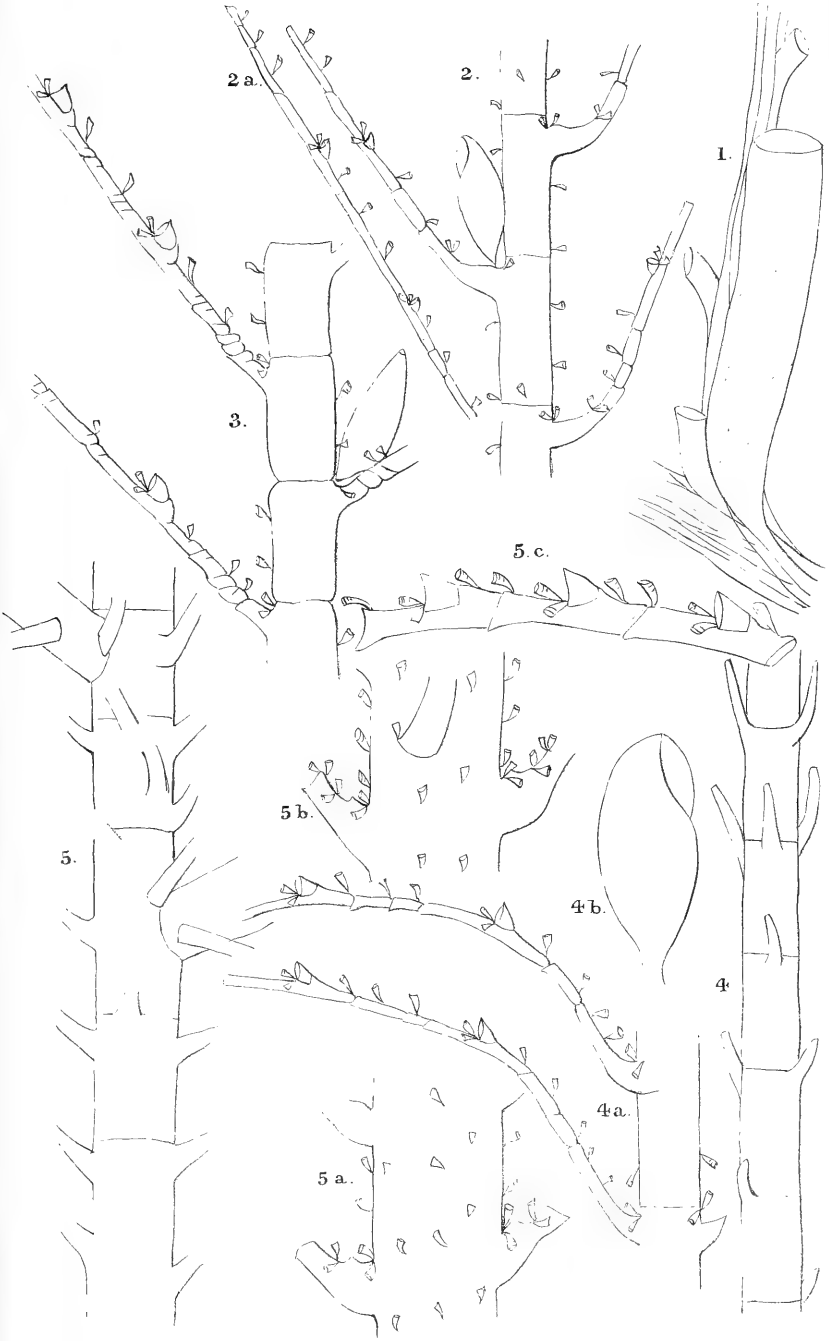

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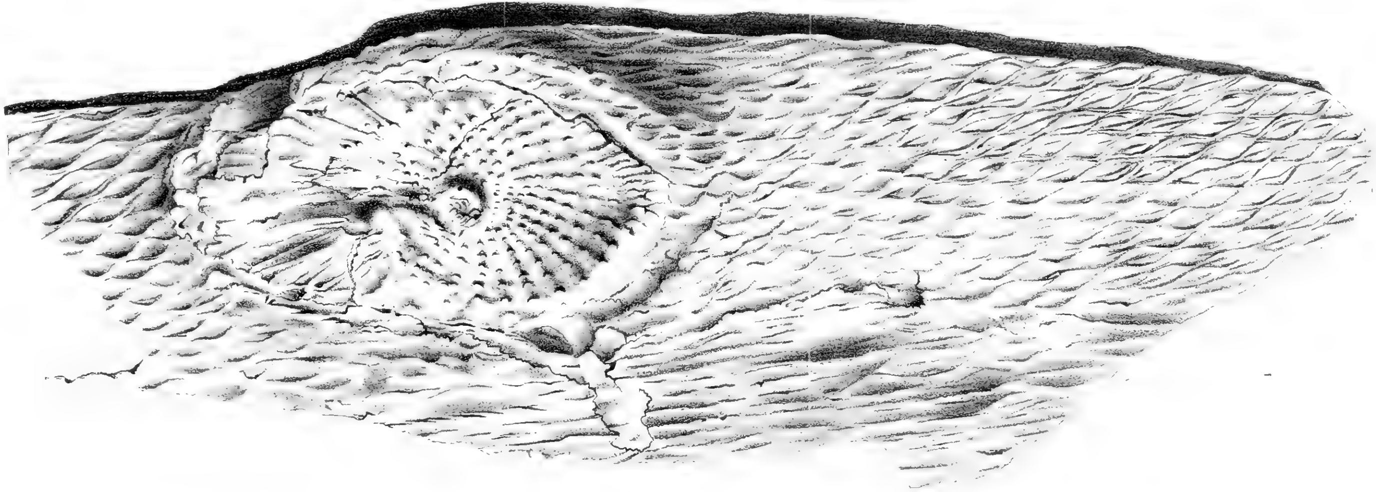

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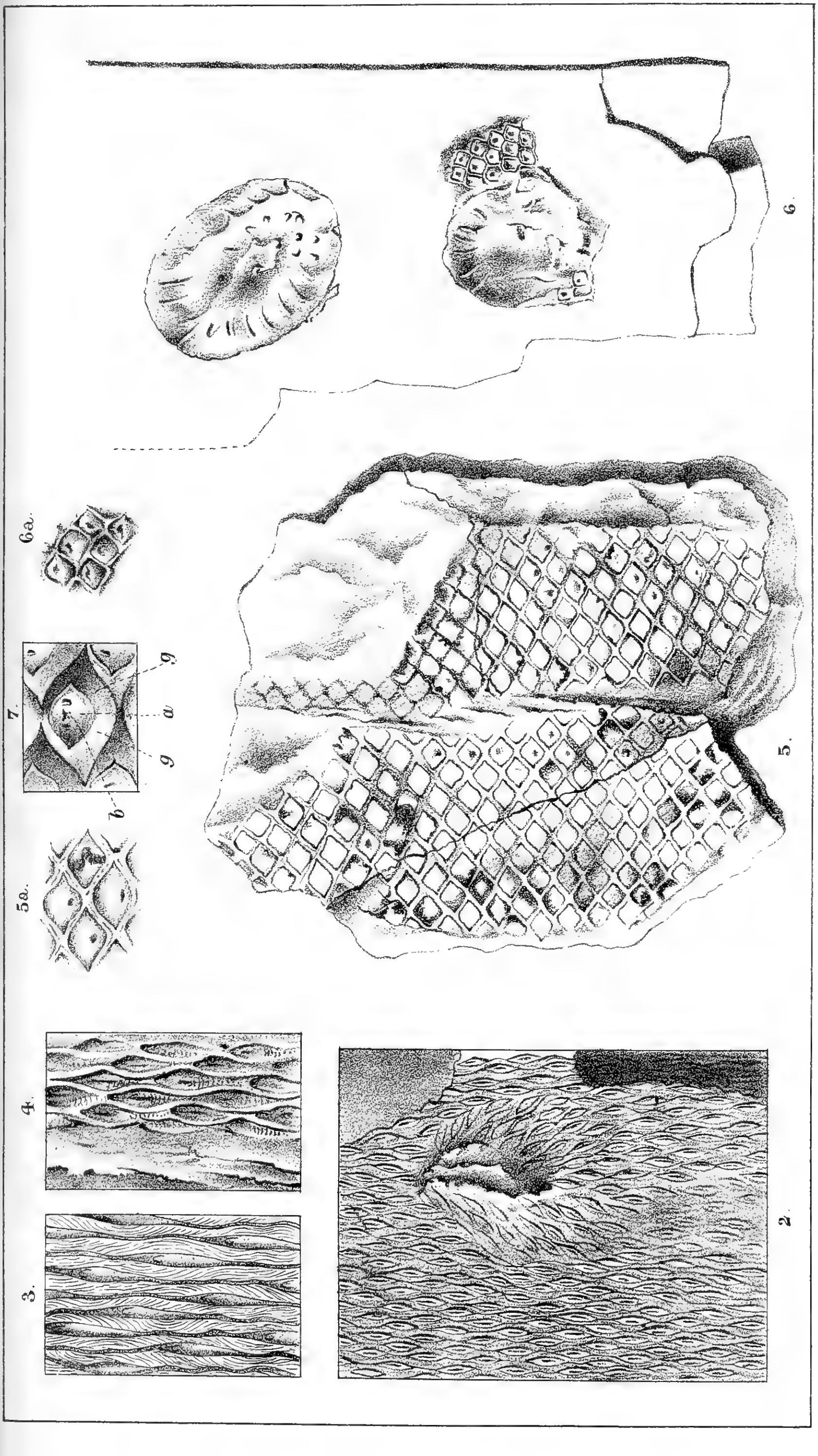

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2–4. *Lepidodendron Veltheimianum*, Sternb. 5. *Sigillaria discophora*, Konig. sp. 6 *Sigillaria Taylori*, Carr. sp. 7 *Sigillaria Brardii*, Brongt.

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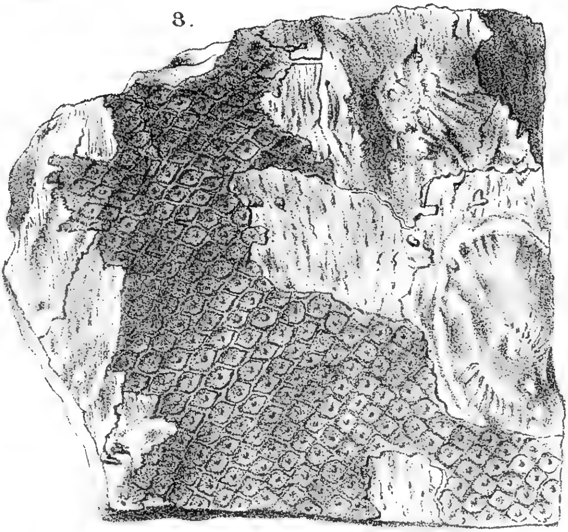

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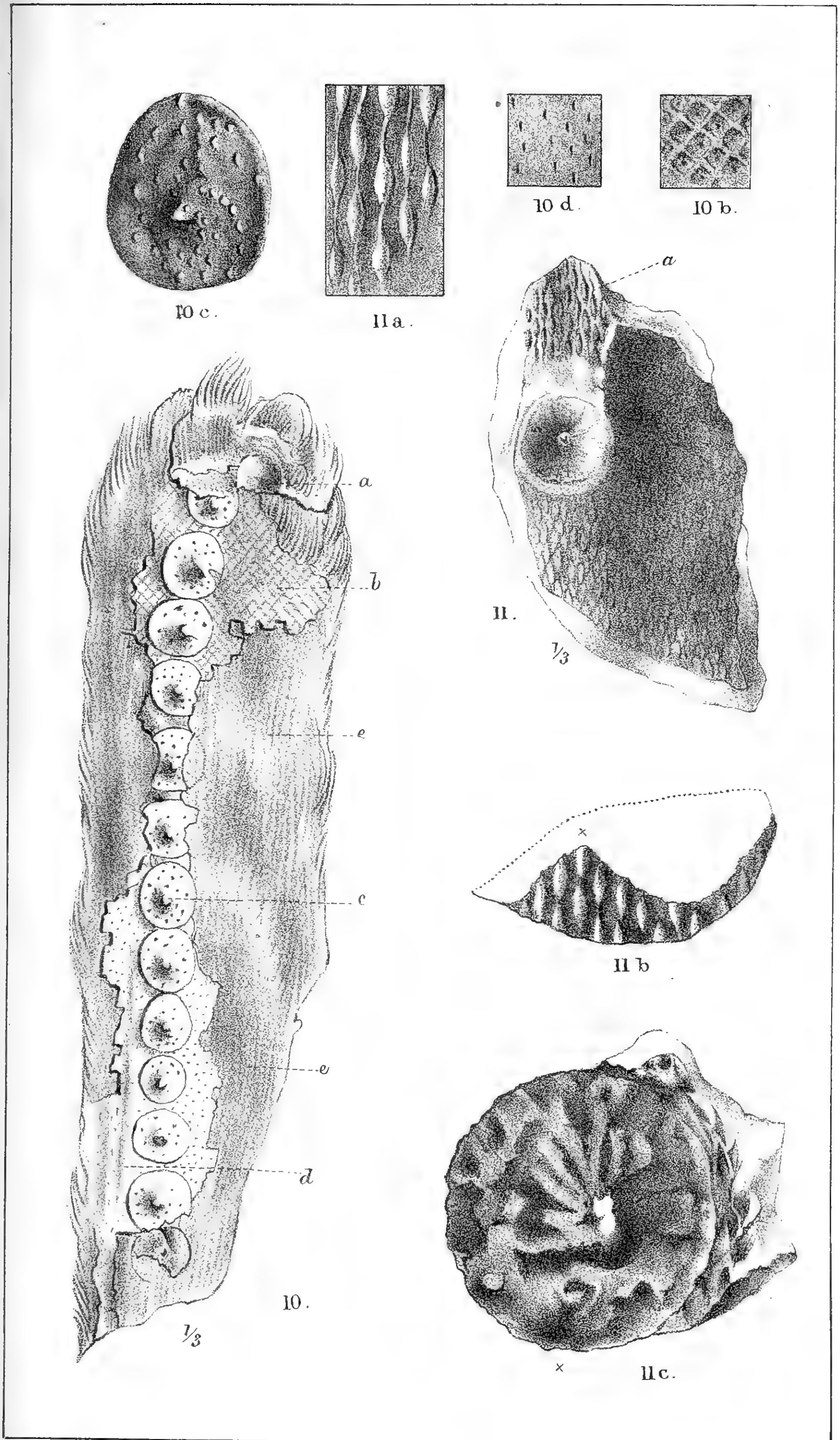
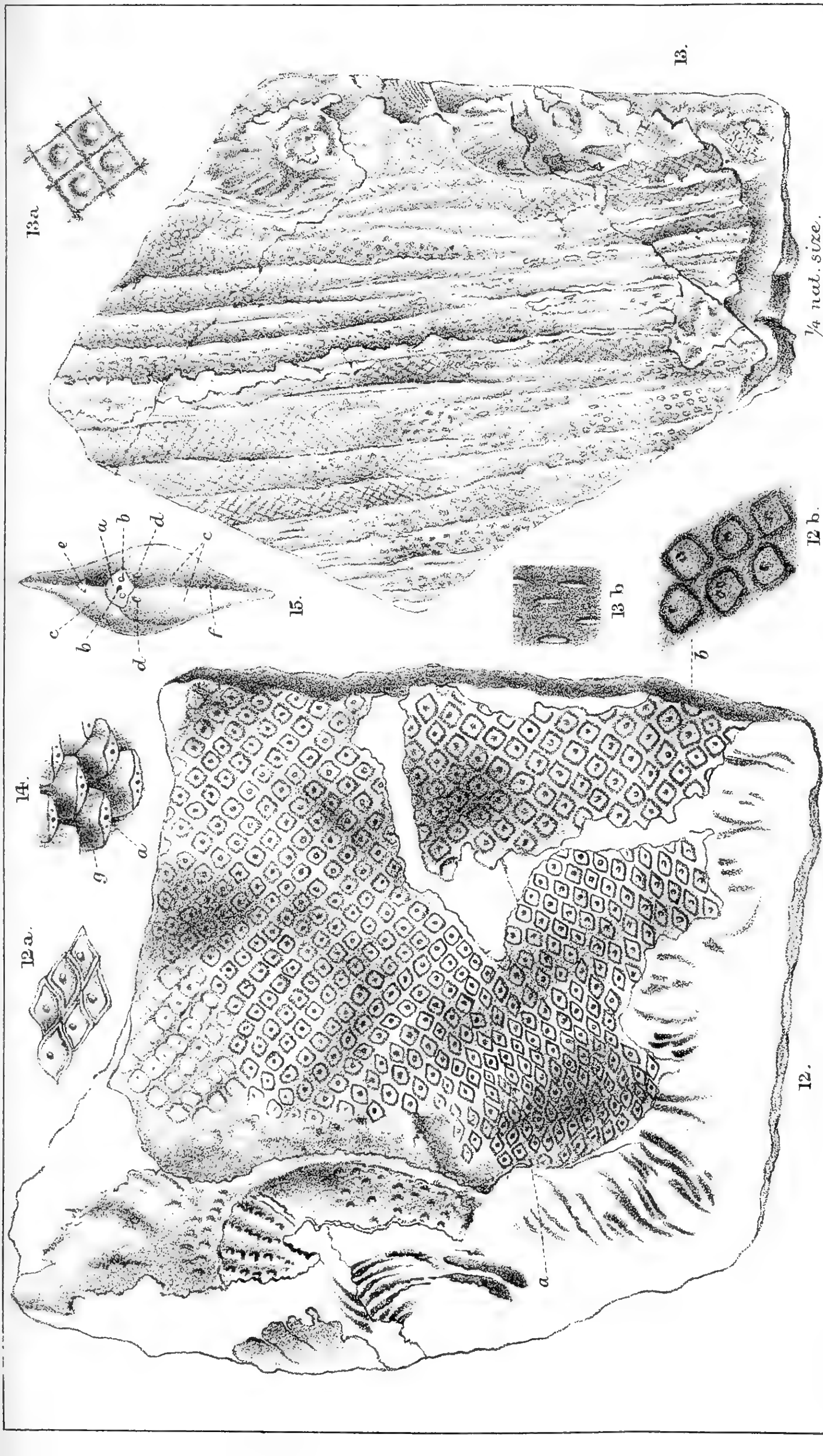
8. *Sigillaria discophora, Konig sp.* 9. *Sigillaria Taylori, Carruthers sp.*



R. Kidston del. Mintern Bros. lith.

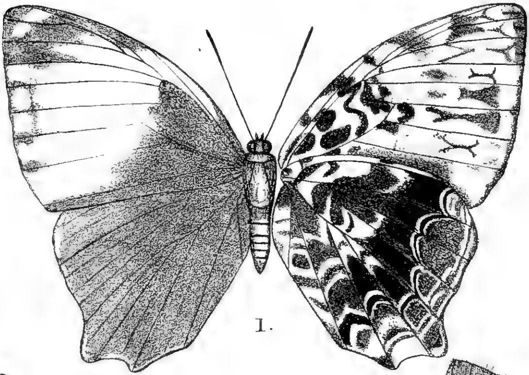
10. Sigillaria Taylori, Carruthers sp. *11. Lepidodendron Veltheimianum, Sternberg.*



12–13. *Sigillaria discophora*, Konig sp. 14. *Lepidophloios scoticus*, Kidston. 15. *Lepidodendron*.

R Kidston del.

Mintern Bros. lith.



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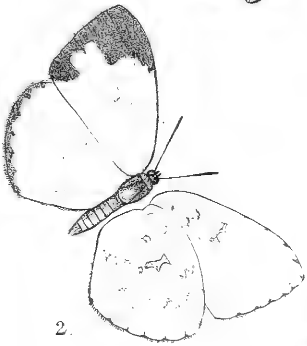

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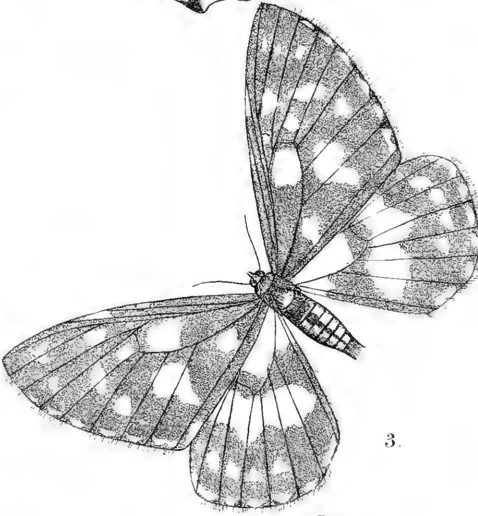

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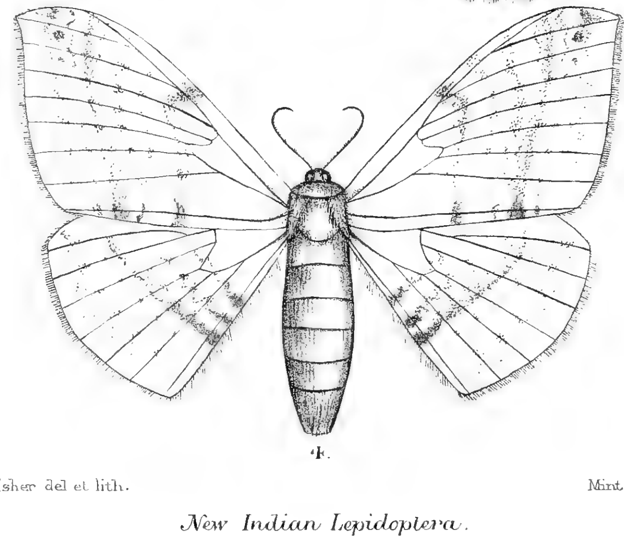


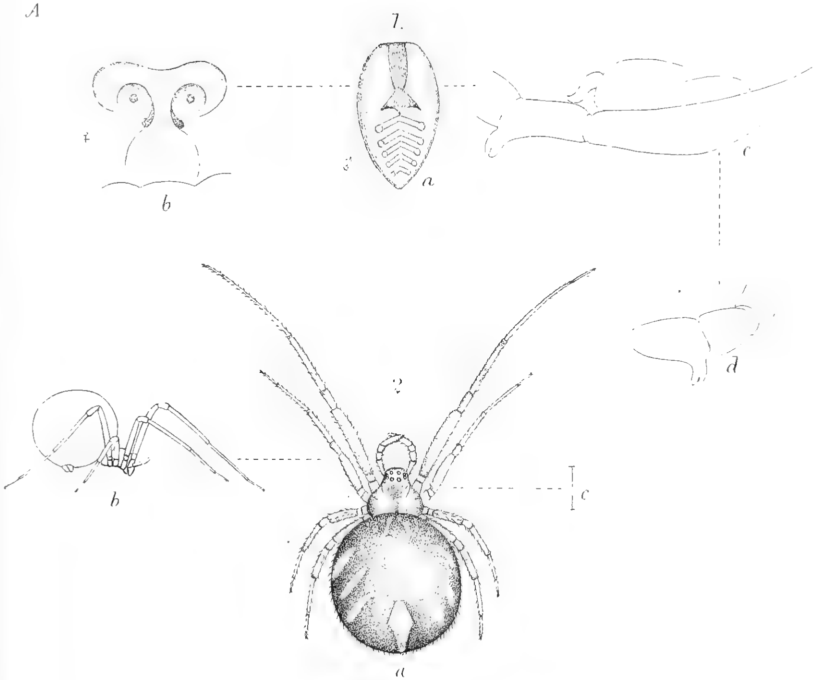
4.

M. Horman-Fisher del et lith.

Mintern Bros. imp.

New Indian Lepidoptera.

A



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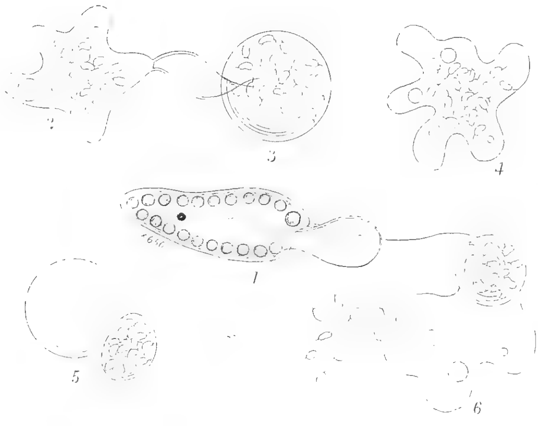
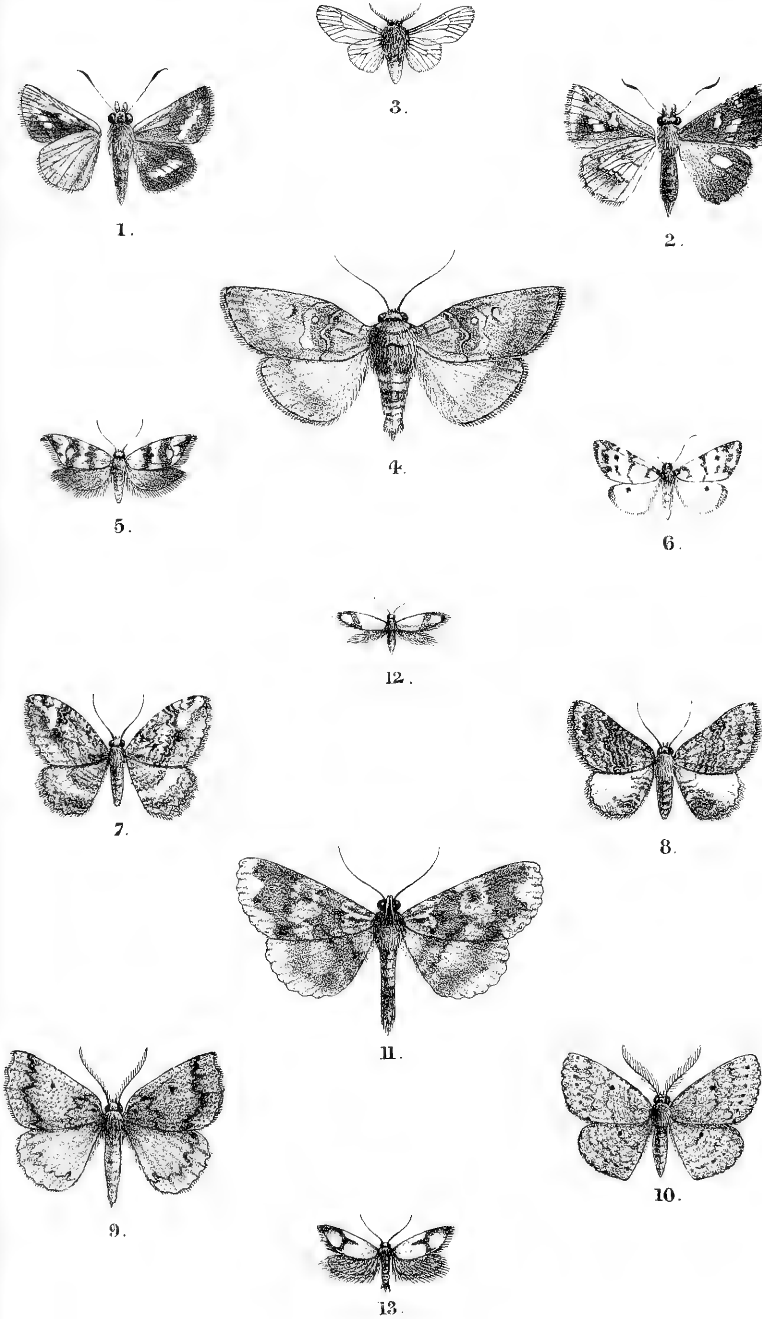


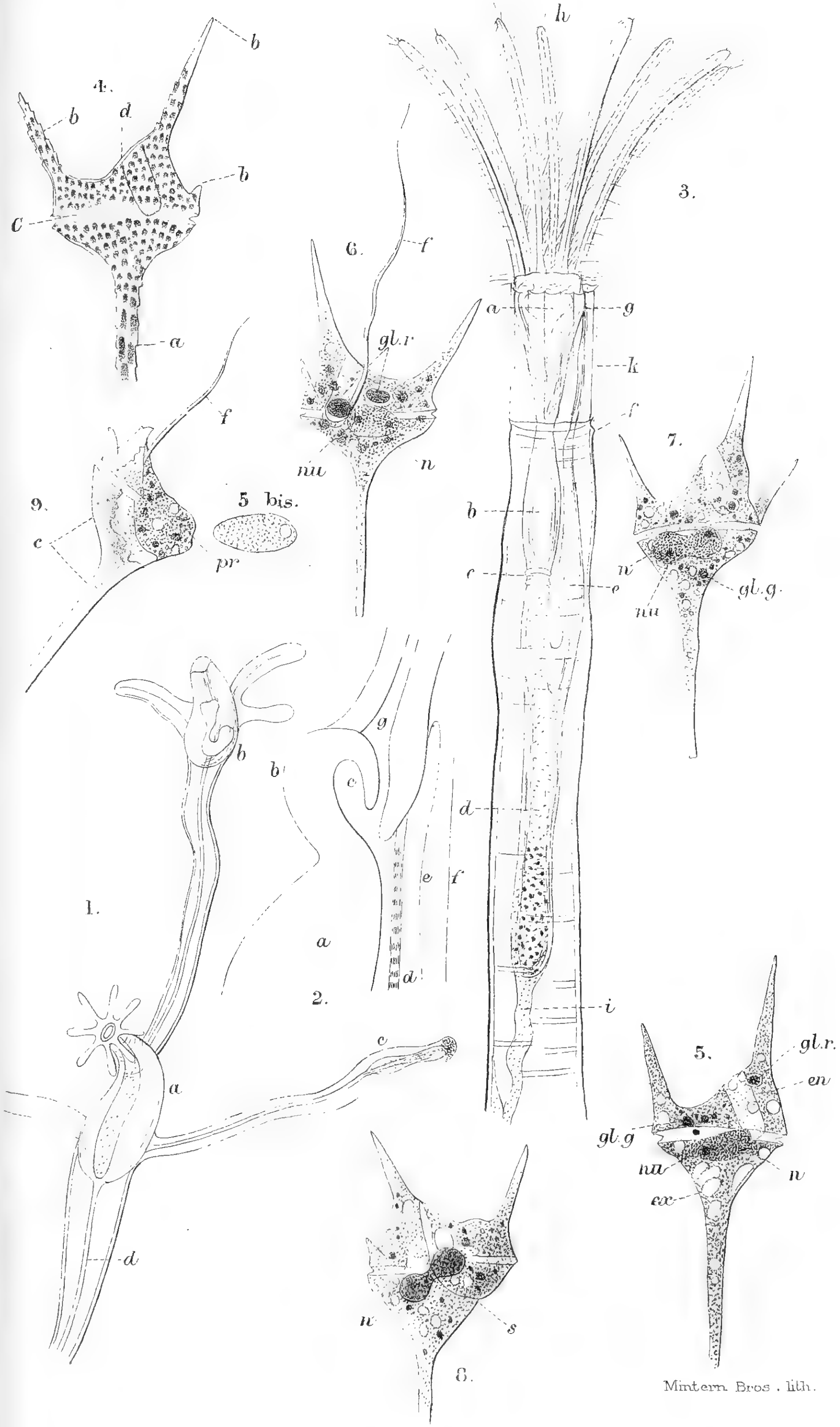
Mintern Bros. sc.

Mintern Bros. lith.



Mintern Bros. lith.

NEW AUSTRALIAN LEPIDOPTERA.



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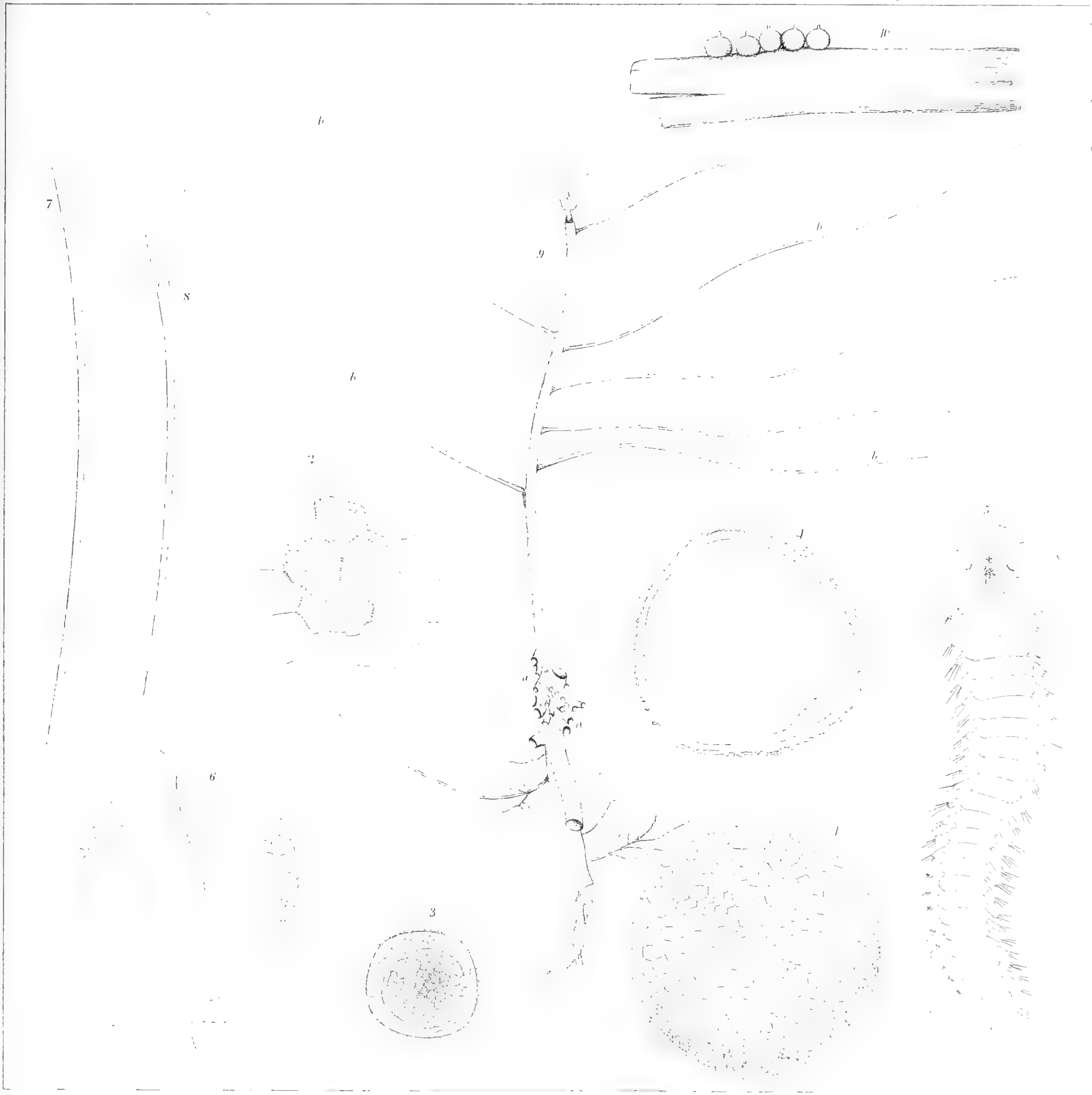
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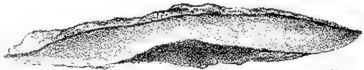
1

E.E. Prince del.

Gastrosteus spinachia, L.

Mintern Bros. sc.



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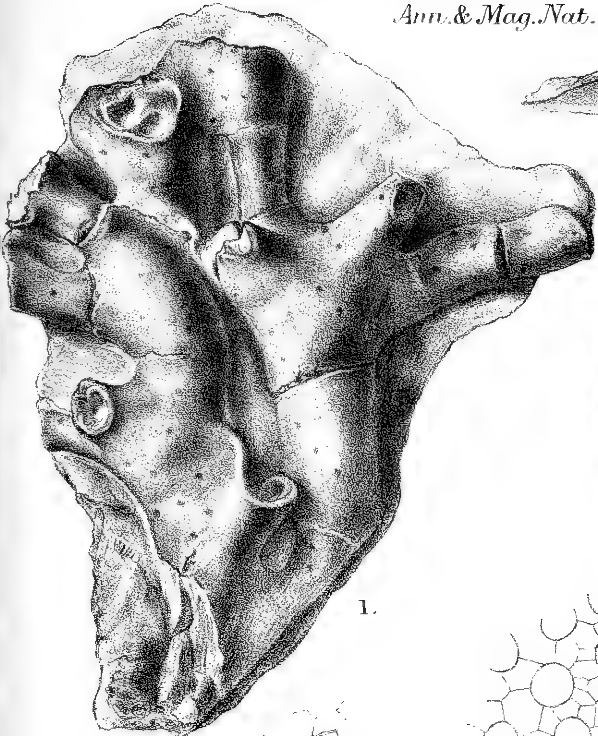

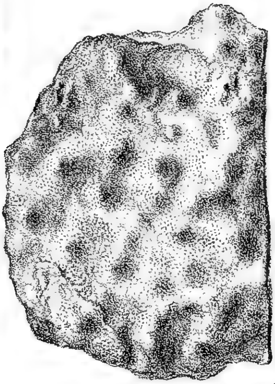

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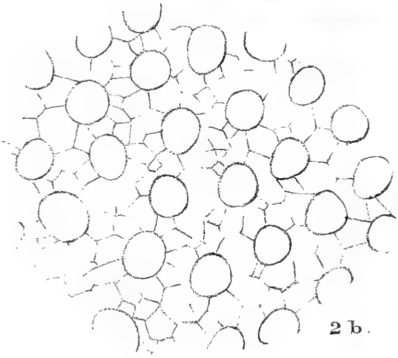

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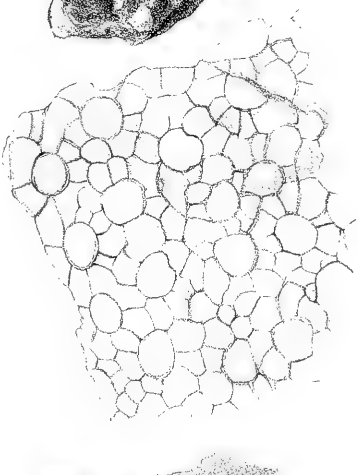

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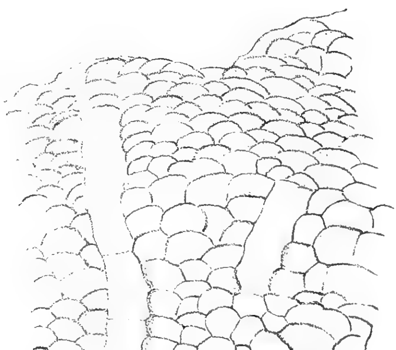
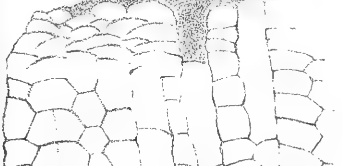


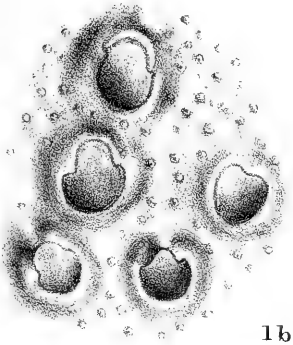


2 c.

3 a.

A. S. Foord, lith. A. H. F. del.

Mintern Bros. imp.



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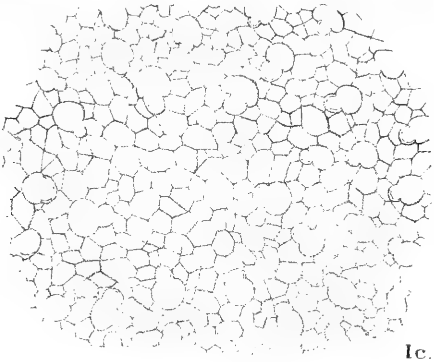

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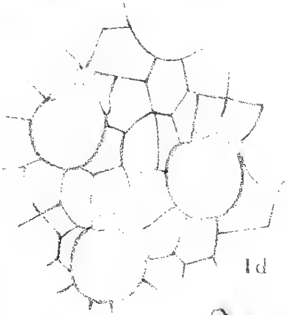

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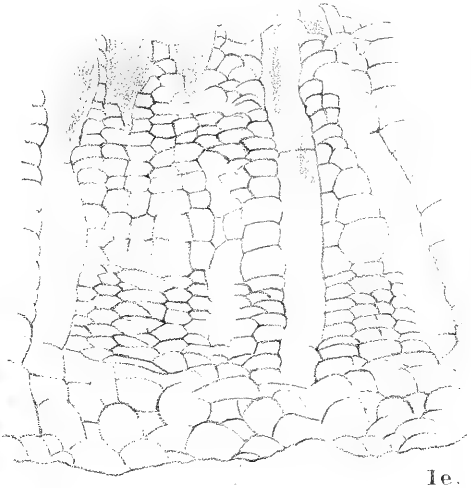

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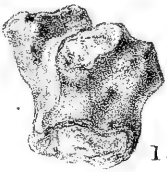

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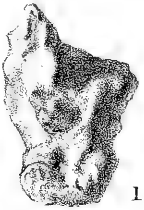

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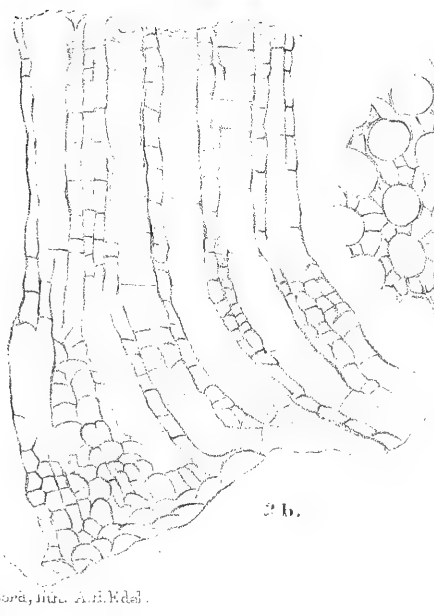

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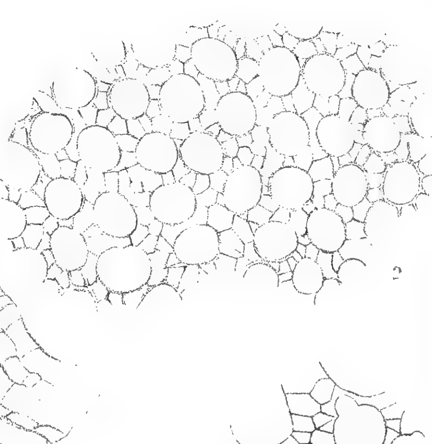

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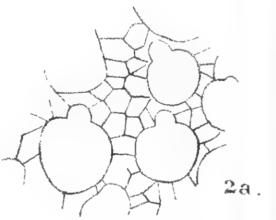
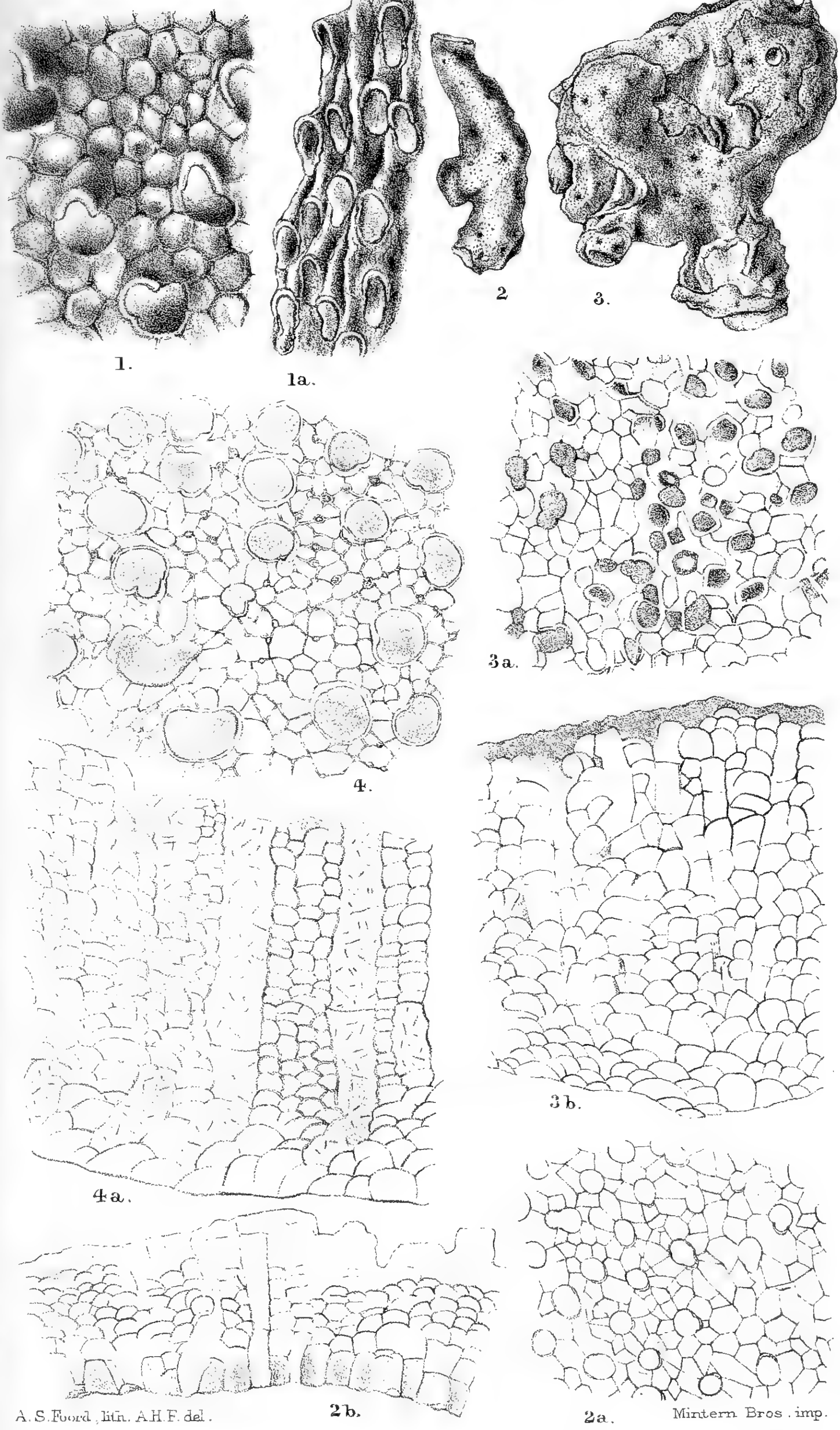


2a.

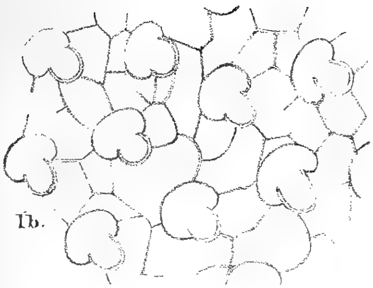
A. S. Foord, lith. A. H. F. del.

Mintern Bros. imp.



A. S. Foord, lith. A.H.F. del.

Mintern Bros. imp.



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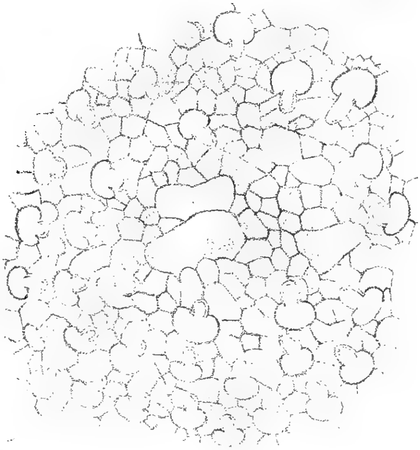

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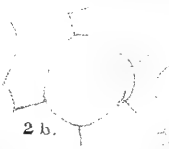

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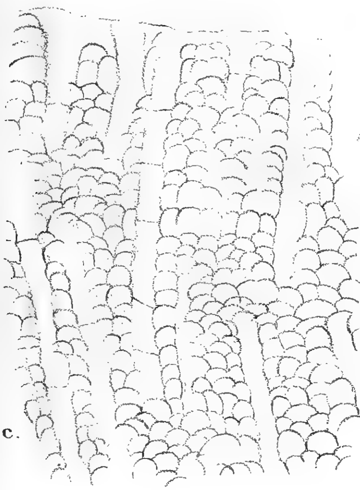

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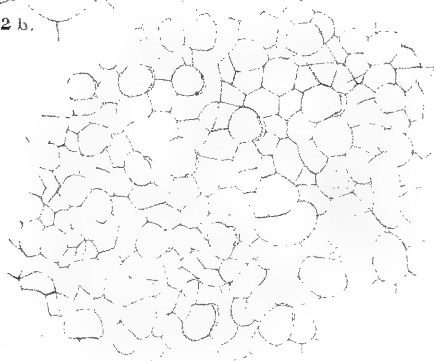

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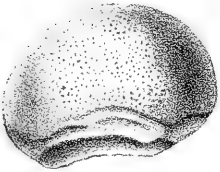

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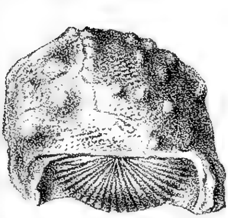

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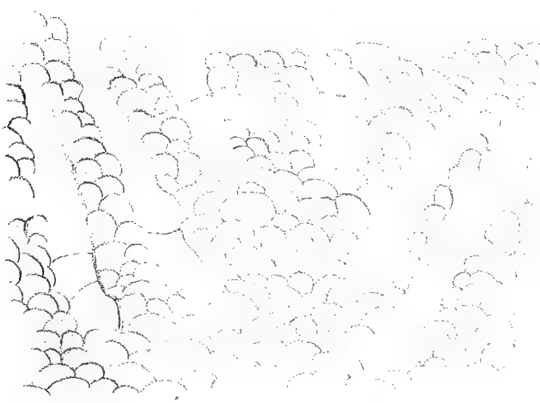

2c.

A.S. Foord, lith. A.H.F del.

Mintern Bros. imp.